Appendix F

WRF Pilot Filtration Testing Results

Parametrix
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TECHNICAL MEMORANDUM

DATE:	April 29, 2015
TO:	Al Bolinger, Carl Jones, and Greg Zentner Washington State Department of Ecology (Ecology)
FROM:	David M. Kopchynski, PhD, P.E
SUBJECT:	Test Report for Pilot Denitrifying Filter Unit
CC:	Ryan Johnstone, P.E., City of Yelm
PROJECT NUMBER:	216-1781-033 (03/05A)
PROJECT NAME:	WRF Facility Plan

4-29-15

INTRODUCTION

The City of Yelm (City) and its wastewater consultant, Parametrix, are investigating the best short-term possibilities of dosing an external carbon source into the Yelm Water Reclamation Facility (WRF) treatment process train to enhance denitrification. This test report, specifically demonstrates the successful dosing of an external carbon source, MicroC 2000™ to the influent of a pilot test filter in order to activate denitrification capability of the test filter. Based on the report results, it is the City's intent to obtain approval from Washington Department of Ecology (Ecology) to proceed with full-scale testing of carbon addition at the Yelm WRF filtration facility.

Currently, the Yelm WRF operates full-scale, upflow continuous backwashing filters in contact filtration mode to only remove total suspended solids (TSS) and turbidity from the sequencing batch reactor (SBR) effluent. Contact filtration is defined as coagulant addition with mixing only before media filtration.

This memorandum describes results from a pilot test where an external carbon source was added to WRF unfiltered, coagulated SBR effluent. The dosed effluent was then passed through a test filter that was similar in configuration to the existing WRF full-scale filters (i.e., pilot unit is also an upflow continuous backwashing filter and using a similar sand media depth [2 meters] as the WRF full-scale filters). The addition of an external carbon source or carbon supplementation to the tertiary filters is primarily conducted to allow denitrification to occur within the filters. This process is commonly known as the tertiary denitrification filter process.

The tertiary denitrification filter process has been successfully implemented in municipal wastewater treatment plants and is described in an EPA Wastewater Management Fact Sheet which is provided in Attachment E for reference.

The purpose of the pilot testing was to determine the following:

1. Can filter denitrification conditions occur at low effluent water temperatures, specifically at temperatures below 12 degrees Celsius?

2. Confirm that a synthetic, external carbon source, such as MicroC 2000™, can be successfully employed to create denitrification conditions in the pilot test filter. MicroC 2000™ has lower flammability and safety requirements than methanol. More detailed information on this product is provided in Attachment B.

3. How will carbon supplementation at the tertiary filters impact the coagulant (aluminum chlorohydrate) dosage and filtration rates to achieve effective turbidity and solids removal to meet reclaimed water permit requirements (2 NTU, average monthly turbidity limit; and 5 NTU, sample maximum turbidity limit; and 30 milligrams per liter average monthly total suspended solids limit)?

4. What levels of dissolved oxygen (DO) are required in the filter influent to allow for effective denitrification and will existing hydraulic structures downstream of the full-scale filters be sufficient to re-aerate filter effluent to the required minimum dissolved oxygen level?

This testing report summarizes the following:

- Specific information on equipment and procedures used for tertiary denitrification filter testing with WRF Sequencing Batch Reactor (SBR) effluent that is coagulated with aluminum chlorohydrate (ACH).
- Summary of testing results and recommendations for full-scale carbon addition operation at the existing WRF filters pending approval from Ecology.
- Information obtained from this test report will be used to vet tertiary filtration as a potential WRF improvement alternative. Detailed costing information for this alternative will be presented in the facility plan currently under development for the Yelm WRF.

SUMMARY OF PILOT TEST RESULTS AND RECOMMENDATIONS FOR FULL SCALE OPERATION

The test results indicate that simultaneous removal of inorganic nitrogen (nitrate and nitrite) and suspended solids removal (to less than 2 NTU) occurred within the test pilot filter under effluent water temperatures recorded as low as 11 degrees Celsius. The pilot testing highlighted the following key information for potential future full-scale operation at the WRF:

1. Low dissolved oxygen levels in the filter influent are critical to allow denitrification microorganisms to be established in upflow continuous backwash filters. Existing flow facilities such as the filter overflow weirs and the chlorine contact weirs were sufficient to re-aerate low dissolved oxygen water to above 1 mg/L.

2. Significant inorganic nitrogen removal can be achieved at carbon dose rates as low as 18 to 25 milligram carbon per liter of pilot test filter flow. This would be equivalent to dosing 9 to 12 gallons of MicroC per day with a WRF full-scale filter influent flow set at 0.6 millions of gallons per day.

3. Carbon dosing can be reduced to optimize the level of nitrogen removal desired.

4. If full-scale filters are carbon supplemented for denitrification, the carbon supplementation should not occur during periods of high nitrate levels in the SBR decants and cold weather in order to control nitrite formation. Nitrite formation is of concern because it has chlorine demand of 5 milligrams per liter. It is expected under full-scale operations that chlorine dose requirements will rise slightly especially if and when full-scale filters are seeded for denitrification operation.

5. Setting proper backwash filter flow rates in continuous upflow backwash filters is important to maintain effluent turbidity levels below 2 NTU when such filters are operated under denitrification and contact filtration modes simultaneously. It is expected that backwash flow requirements would increase for full-scale filters in order to provide turbidity less than 2 NTU while operating these filters in denitrification mode.

6. Rapidly switching from MicroC to methanol carbon feed to maintain test filter denitrification was not successful for this testing.

EQUIPMENT, SERVICES, AND MATERIALS EMPLOYED

The following existing treatment plant equipment was employed for pilot testing:

Pilot equipment, services, and materials that were provided by the filter manufacturer included:

1. Portable filter unit.
2. Portable compressed air system.
3. Sand for the filter unit.
4. On-line instrumentation to continuously monitor dissolved oxygen, oxidation-reduction potential (ORP), temperature, pH, Nitrate and Nitrite.
5. The rental agreement and further details of the pilot filter test equipment are provided in Attachment C.

Equipment, services, or materials provided by the City for the pilot testing included:

1. Existing WRF filter influent sample pump and suction sample piping. The existing WRF filter influent sample pump (currently 1/2 horsepower) was replaced with a slightly larger pump of similar style (3/4 horsepower) to allow for proper feed flow to the pilot test unit and to provide sufficient slip stream flow into the existing WRF filter influent turbidity and pH on-line analyzers.
2. The full flow from the existing WRF filter influent sample pump as directed through a 2-inch-diameter PVC feed hose piping to the pilot test filter.
3. Existing WRF filter influent (coagulated SBR effluent) pH and turbidity on-line analyzers.
4. Process drain hoses to convey pilot filter treated and backwash flows into a plant drain.
5. Single 270-gallon tote of MicroC 2000™.
6. On-site laboratory staff services labor and equipment to conduct turbidity, total suspended solids, dissolved oxygen, ammonia, nitrate, nitrite and biochemical oxygen demand (BOD) analyses.
7. Upgraded raw filter influent sample pump that will deliver sufficient flow to the pilot test unit.
8. Hoses and flow controls to direct flow from the WRF filter influent sample pump into the pilot filter. The City also provided hoses from the pilot test unit discharge points over to an area drain.
9. Lifting equipment (fork lift or crane) and labor to unload and reload pilot filter equipment.

PILOT TEST SETUP PROCEDURE

The pilot plant facilities were set up in the following order:

1. Pilot Test Unit Setup

The pilot testing unit was set up in covered sludge truck loading bay adjacent to the belt filter press room. The filter was set in such a way to allow continued and uninterrupted loading of thickened waste activated sludge within the designated loading area.

The City provided a forklift and required labor to unload, set up, shut down and reload the filter unit for shipping back to manufacturer. Manufacturer technicians were present to assist in the setup of and take down of pilot filter unit.

Pilot test filter drain and backwash waste hoses were extended to the existing drain located on the sludge loading area pad. This discharge flow was returned to the head of the WRF via the reject water pump station.

2. Pilot Test Unit Feed Pumping and Piping Systems Setup

Since the WRF filter influent sample pump is only used for internal plant monitoring purposes, its operation was temporarily shut down to allow the following pump and piping modifications to be implemented during the pilot study:

- City procurement and installation of a larger 3/4 horsepower sample pump, valves, and a sample flow metering device for the portion of the WRF influent filter flow directed in the pilot test filter.
- Conversion of the supply and return piping of the WRF filter influent sample pump into supply lines in order to provide higher flows to the pilot unit.
- Connection of new sample pump discharge to the inlet of the pilot test filter using a flexible hose.

3. Sampling and Testing Equipment Setup

Because of the availability of on-line instrumentation, auto-sampling equipment was not employed per the original test plan. Attachment D contains the original test plan for reference. Figures are provided in Attachment E. Grab samples were taken and analyzed as directed in the modified Testing Plan Procedures below.

General locations of pilot testing equipment are shown in Figure 1. A basic summary of how piping and pilot test components were tied into existing WRF facilities is provided in Figure 2.

TESTING PLAN PROCEDURES

The pilot testing was approximately three months in duration. Pilot test operation commenced January 7, 2015 and ended on March 20. The primary purpose of the pilot test was to confirm the following operational criteria before full-scale implementation can be considered:

- How will cold temperature conditions impact filter denitrification rates.
- What denitrification rates will be achievable at filter loading rates of 2 and 3 gallons per minute per square foot of filter using a range of MicroC dose rates?

- How will filter denitrification impact the contact filtration process and what impacts on effluent turbidity and coagulant dosage will occur?
- How will dissolved oxygen in the pilot filter influent impact the filter denitrification rates? During pilot testing, the SBR effluent equalization storage pond mixer was shut down to better control the amount of dissolved oxygen in the coagulated SBR effluent flow being delivered to the pilot filter.

Pilot Filter Information

The pilot filter was a Supersand Model DSTO7 AD provided by WesTech. The pilot filter had the following characteristics:

Table 1. Pilot Filter Parameters

Pilot Filter Parameter	Value
Filter Type	Continuous backwash sand filter
Diameter	3-foot diameter
Cross-Sectional Area	7.065 feet
Sand Depth	6.56 feet or 2 meters

For comparative purposes the design parameters for the existing full-scale WRF sand filters are provided as follows:

Table 2. WRF Full Scale Filter Parameters

Pilot Filter Parameter	Value
Filter Type	Continuous backwash sand filter
Number of Modules	6
Sand Lift Modules per Filter Basin	2
Number of Filter Basins	3
Filter Area Per Sand Lift Module	50 square feet
Total Filter Area, All 3 Three Basins in Service	300 square feet
Current Filter Basins in Operation	3
Current Filtration Rate (Based on Intermediate Pump Station [IPS] Flow Ranging from 0.55 to 0.60 millions of gallons per day)	1.3 to 1.4 gallons per minute per square foot
Aluminum Chlorohydrate Coagulant Dosage during Pilot Testing	1.1 to 1.3 gallons per day
Sand Depth in each Basin	6.56 feet or 2 meters

Pilot Test Sampling and Analysis Plan

Deviations from the original test plan were primarily brought about due to the manufacturer providing a significant amount of on-line instrumentation (DO, pH, ORP, nitrate, nitrite analyzers) for the pilot test unit that eliminated the need for composite sampling.

The original test plan was modified (additions highlighted in red and deletions indicated as strikethrough text) as follows for the pilot test:

Frequency of and Type of Sampling/Readings During Pilot Filter Operation	Analyses to be Conducted on Sample
Up to Three Times a Week – Effluent Daily Grab ~~Composite~~ Sample	Effluent ~~DO~~, nitrite, Total Kjeldahl Nitrogen (TKN), ~~ammonia,~~ nitrate, COD, BOD, and turbidity analyzed at WRF laboratory.
Up to Three Times a Week – Grab Sample	Pilot filter ~~influent dissolved oxygen, temperature, pH~~, flow, COD, ~~ammonia~~, nitrate, nitrite, TKN. ~~and oxidation reduction potential (ORP).~~ Pilot filter effluent dissolved oxygen, temperature, pH, and ORP. All tests conducted using hand held meters, local WRF instrumentation, or WRF lab equipment provided at the pilot test location. Testing data was also pulled from process monitoring tests already being performed on WRF filter influent.----- Note all times when grabs are taken and processed.
Recording of Values or Field Measurements for Each Week Day	Volume of MicroC or Methanol used up since last reading taken. Current coagulant dosage applied at full-scale filters. Head loss across filter. Backwash waste flow rate. Influent flow rate to pilot filter. In field dissolved oxygen measurements at the WRF SBR effluent equalization storage pond and at the reclaimed water pump station wet well. Note time when readings are taken.
~~Once a Week – Effluent Daily Composite Sample Quality Control Check~~	~~Effluent TKN, nitrate, nitrite, ammonia, turbidity, and COD to be analyzed by an outside laboratory.~~

Analysis of samples were conducted up to three times a week on weekdays. During weekends, no samples were obtained or analyzed. WRF plant staff conducted analyses only on grab samples and used internal quality controls rather than an outside laboratory for verification of testing accuracy.

The following equipment or testing methods were used to analyze samples:

- pH – WRF laboratory bench top meter.
- Turbidity – WRF laboratory bench top meter, Quality Assurance/Quality Control (QA/QC) samples to be analyzed with known standards. ~~by outside laboratory accredited by Ecology.~~
- ORP – WRF handheld meter.
- pH – WRF lab bench top meter.
- Dissolved Oxygen and Temperature – WRF handheld meter.

- BOD – Using WRF laboratory equipment and Standard Method 5210B, WRF laboratory is accredited by Ecology to conduct BOD tests.
- COD – Using WRF laboratory equipment and Standard Method 5220D; ~~QA/QC samples to be analyzed by outside laboratory accredited by Ecology.~~
- Ammonia, Nitrite, Nitrate and TKN – WRF laboratory bench top ion selective nitrate electrode calibrated weekly to biweekly by WRF staff and checked against known standards. ~~or spectrophotometer; WRF is certified by Ecology to performance ammonia analysis for compliance testing. QA/QC samples to be analyzed by outside laboratory accredited by Ecology~~

Pilot System Operation Plan and Observations

To provide information for the above operational criteria, the following test schedule and protocol matrix was conducted. Due to significant WRF process fluctuations, manufacturer recommendations for startup, and carbon dosing feed rate limitations, the original test plan was modified as follows:

Test Time Period	Testing Activity and Observations
Jan. 7 ~~Day 1~~ through Jan. 20 ~~Day 7~~ – Setup and Startup	Filter flow and carbon feed to pilot filter commenced on January 7, 2015. ~~Operate filters at 1 gallons per minute per square foot loading rate~~ Filter influent flow was set to approximately 14 gallons per minute or 2 gallons per minute per square foot as recommended by manufacturer and MicroC carbon feed rate was maintained in the 6 to 9 milliliter per minute feed range. The corresponding flow based dosage rate was 125 to 200 milligram of MicroC per liter of influent flow. Backwash flow rate held as low as possible by flooding the pilot filter backwash waste overflow weirs (to aid in ~~seeding~~ building denitrifier organisms in the pilot filter, but effluent turbidity was found to be above 2 NTU by reducing backwash flow. ~~Initially the filter was operated with a minimal bed turnover time to allow development of biology within the filter sand media. Pilot filter may be seeded with WRF mixed liquor to more quickly activate filter biology.~~ Adjusted WRF full-scale SBR effluent equalization (EQ) storage pond mixer operation to provide less than 1 milligram per liter of dissolved oxygen in the SBR decant equalization pond in order for the pilot effluent DO level to fall to below 1 milligram per liter. Verified that reclaimed water pump station wet dissolved oxygen levels were above 5 milligrams per liter due to re-aeration that occurs across WRF filter effluent weirs and across WRF chlorine contact basin weirs. Water temperature was only 11 to 12 degrees during the seeding period. Influent nitrate levels were at 20 milligrams per liter in the influent due to a plant process upset. Starting on January 16 and running through Jan. 19 the pilot filter effluent nitrate dropped to less than 1 milligram per liter as N while the nitrite levels rose rapidly up to as high as 9 milligrams per liter as N.
~~Day 7 through Day 21 – Operation Mode 1~~	~~Operate filters at 2 gallons per minute per square foot loading rate, provide initial 30 milligrams per liter as chemical oxygen demand (COD) MicroC dosage rate*, and step up MicroC dosage to achieve at least 3 to 5 milligrams per liter of nitrate across filter during mode test period.~~

~~Day 21 through Day 35 – Operation Mode 2~~	~~Operate filters at 3 gallons per minute per square foot loading rate, provide initial 30 milligrams per liter as COD MicroC dosage rate[a], and step up dosage to achieve at least 3 to 5 milligrams per liter of nitrate across filter during mode test period.~~
~~Day 21 through Day 60 – Operation Mode 3~~	~~Operate filters at optimal loading rate determined from Modes 1 and 2 test periods but attempt to increase MicroC dosage under this mode of operation to achieve higher removal rates of nitrate (5 to 7 milligrams per liter) across the pilot test filter.~~
Jan. 20 through Jan. 30 – Initial Successful Removal of Nitrates Using MicroC	The above testing plan operation phases were abandoned due to variable influent nitrogen levels coming out the WRF SBRs. For this operating phase, the MicroC 2000 dosing pump feed rate to the pilot was maintained in the 6 to 8 milliliter per minute range. This dose rate represents a flow based dose of 40 to 60 milligram of MicroC per liter of influent flow. It was noted that rapid changes in MicroC 2000 carbon dose rate during this period caused a rapid rise in pilot filter effluent nitrite levels. Filter flow and loading rates during this period were held at around 14 gallons per minute and 2 gallons per minute per square foot respectively. Influent nitrate into the pilot ranged from 15 to 20 milligrams per liter as N during this period. Generally after a 2-day period, the pilot filter adjusted to dose and flow changes and was able to produce an effluent with no nitrate present, and only a small amount of nitrite ranging from 0.1 to 0.5 milligrams per liter as N even with influent nitrate levels well above 10 milligrams per liter as N.
Jan. 30 through Feb. 19 – Successful Removal with Reduced Use of MicroC	For this period the MicroC rates were adjusted down from the 6 to 8 milliliter per minute to the 2 to 3.5 milliliter per minute range and filter influent flow rate was raised from 14 gallons per minute to 20 gallons per minute. The purpose of this test stage was to reduce carbon dose levels and to see if nitrogen removal across the pilot filter could be maintained at the higher hydraulic loading rate of approximately 3 gallons per minute per square foot and lower carbon doses. As noted in the previous period, rapid changes in dose rate or in flow rate caused a corresponding and rapid rise in pilot filter effluent nitrite levels. Effluent nitrite levels rose to near the 5 milligrams per liter as N range and nitrate levels rose as high as the 10 to 12.5 milligrams per liter range. Influent nitrate levels to the pilot gradually dropped from 15 milligrams per liter down to 5 milligrams per liter at the end of this test phase. As in the previous phase, the pilot filter adjusted to flow and dose changes and was able to produce an effluent with nitrate and nitrite levels generally at or below 1 milligram per liter
Feb. 20 through March 3 – Partial Removal with Further Reduction of MicroC	For this testing phase the carbon dosing pump was adjusted even lower to 1 to 1.5 milliliters per minute feed range and influent flow to the pilot filter was held up at 20 gallons per minute. This dosing strategy was employed in an effort to only provide partial removal of nitrate in the influent and control carbon usage. Generally success was obtained with this strategy as influent nitrate levels ranging from 5 to 7 milligrams per liter could be reduced down to 2 to 3 milligrams per liter with only traces of nitrite formed. This was accomplished using a MicroC flow based dosage of only 15 milligrams per liter to 30 milligrams per liter MicroC per liter of influent flow.

March 4 through March 13 – Comparison to Methanol	In an attempt to compare MicroC 2000 to other carbon sources, pilot carbon feed was switched to methanol for a short 9 day period. However, no significant nitrogen removal could be accomplished with the short term methanol feed period. It is possible that the denitrifiers within the filter had only acclimated to use MicroC carbon. Also, during this test time frame dissolved oxygen in the pilot filter effluent had risen above 1 milligram per liter due to a requirement to raise aeration levels in the full-scale WRF SBRs.
March 13 to End of Testing on March 24 – Reestablishing Pilot Filter Denitrification Using MicroC	Carbon feed to pilot filter was switched back to MicroC 2000. The dose was briefly kept at a unit carbon dose rate of 80 milligram Carbon per liter of pilot influent flow and was dropped to 30 milligrams per liter once nitrogen removal across the filter was detected. Effective nitrogen removal continued to be accomplished even at the 30 milligrams per liter lower unit carbon dose.

SUMMARY OF PILOT RESULTS AND RECOMMENDATIONS FOR FULL SCALE OPERATION

Key pilot test results are summarized in the following figures, located in Attachment A:

- Figure 3 – City of Yelm WRF Denitrifying Filter Pilot Test – General Flow, Nitrogen and Carbon Dose Info.
- Figure 4 – City of Yelm WRF Denitrifying Filter Pilot Test – Turbidity Information.
- Figure 5 – City of Yelm WRF Denitrifying Filter Pilot Test – Pilot Effluent ORP, Dissolved Oxygen, and Temperature.
- Figure 6 – City of Yelm WRF Denitrifying Filter Pilot Test – Pilot Unit Carbon Dosages and Effluent pH.

Photo of Pilot Filter Effluent (Left) and Pilot Filter Influent (Right)

Front View of Pilot Filter Setup

Back View of Pilot Test Setup

An examination of the test results plots indicates that simultaneous removal of inorganic nitrogen (nitrate) and turbidity removal (to less than 2 NTU) occurred within the test pilot filter under filter effluent temperatures as low as 11 degrees Celsius. The pilot testing highlighted the following key information for potential future full-scale operation at the WRF:

1. Low dissolved oxygen levels in the filter influent are critical to allow denitrification microorganisms to be established in upflow continuous backwash filters.

2. Significant inorganic nitrogen removal can be achieved at carbon dose rates as low as 18 to 25 milligram carbon per liter of pilot filter flow. This would be equivalent to dosing 9 to 12 gallons of MicroC per day with a WRF full-scale filter influent flow set at 0.6 millions of gallons per day.

3. Carbon dosing can be reduced to optimize the level of nitrogen removal desired.

4. If full-scale filters are seeded for denitrification, the seeding should not occur during periods of high nitrate levels in the SBR decants and cold weather in order to control nitrite formation. Nitrite formation is of concern because it has chlorine demand of 5 milligrams per liter. It is expected under full-scale operations chlorine dose requirements will rise slightly especially if and when full-scale filters are seeded for denitrification operation.

5. Setting proper backwash filter flow rates in continuous upflow backwash filters is important to maintain effluent turbidity levels below 2 NTU when such filters are operated under denitrification and contact filtration modes simultaneously. It is expected that backwash flow requirements would increase for full-scale filters in order to provide turbidity less than 2 NTU while operating these filters in denitrification mode.

Attachment A

Figures Summarizing Testing Results

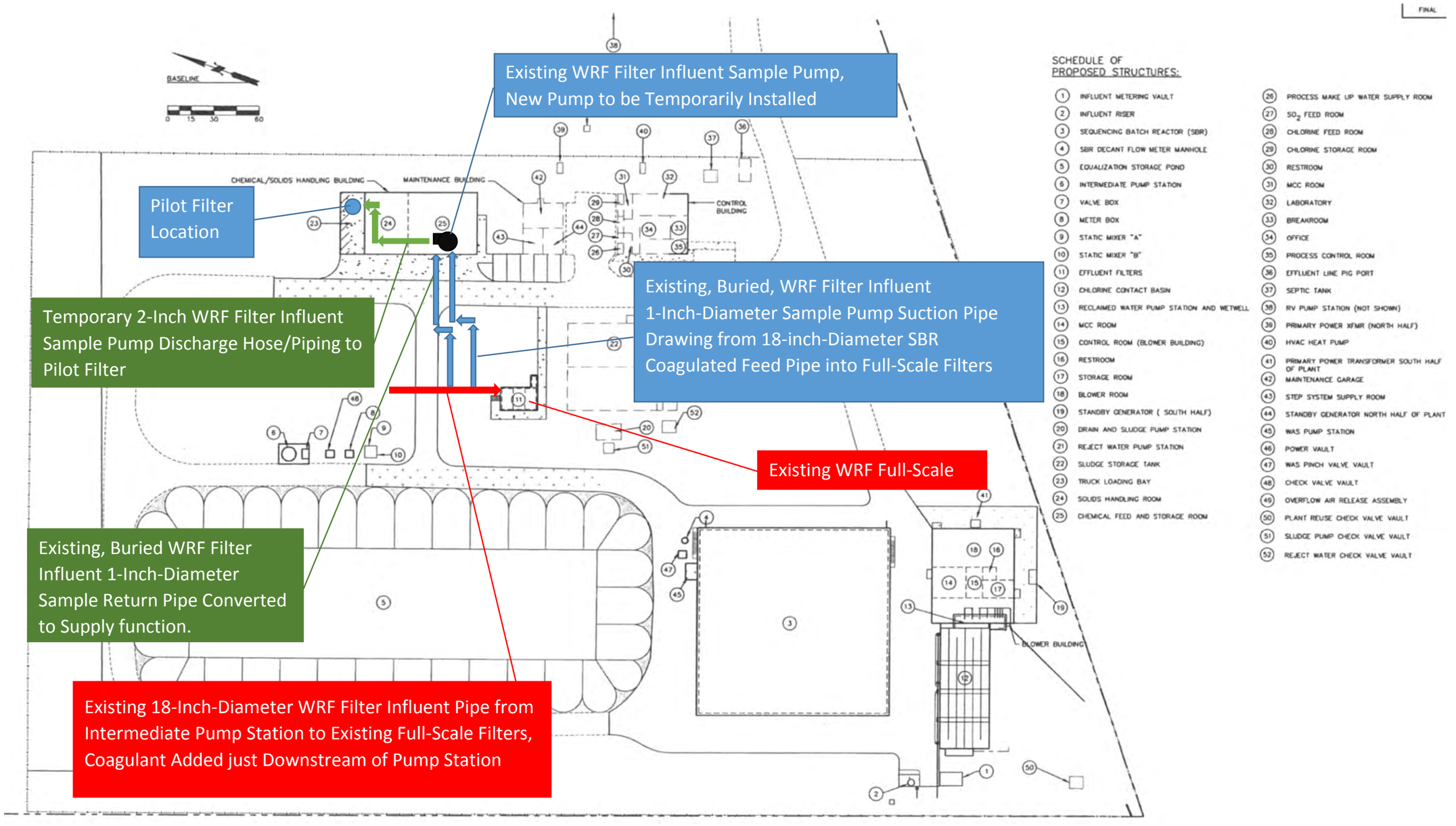


Figure 1 – WRF Site Plan
(Note: Modified From Sheet Z-1 – Process Zones, Skillings and Connolly 1999 City of Yelm Water Reuse Project Record Drawings)

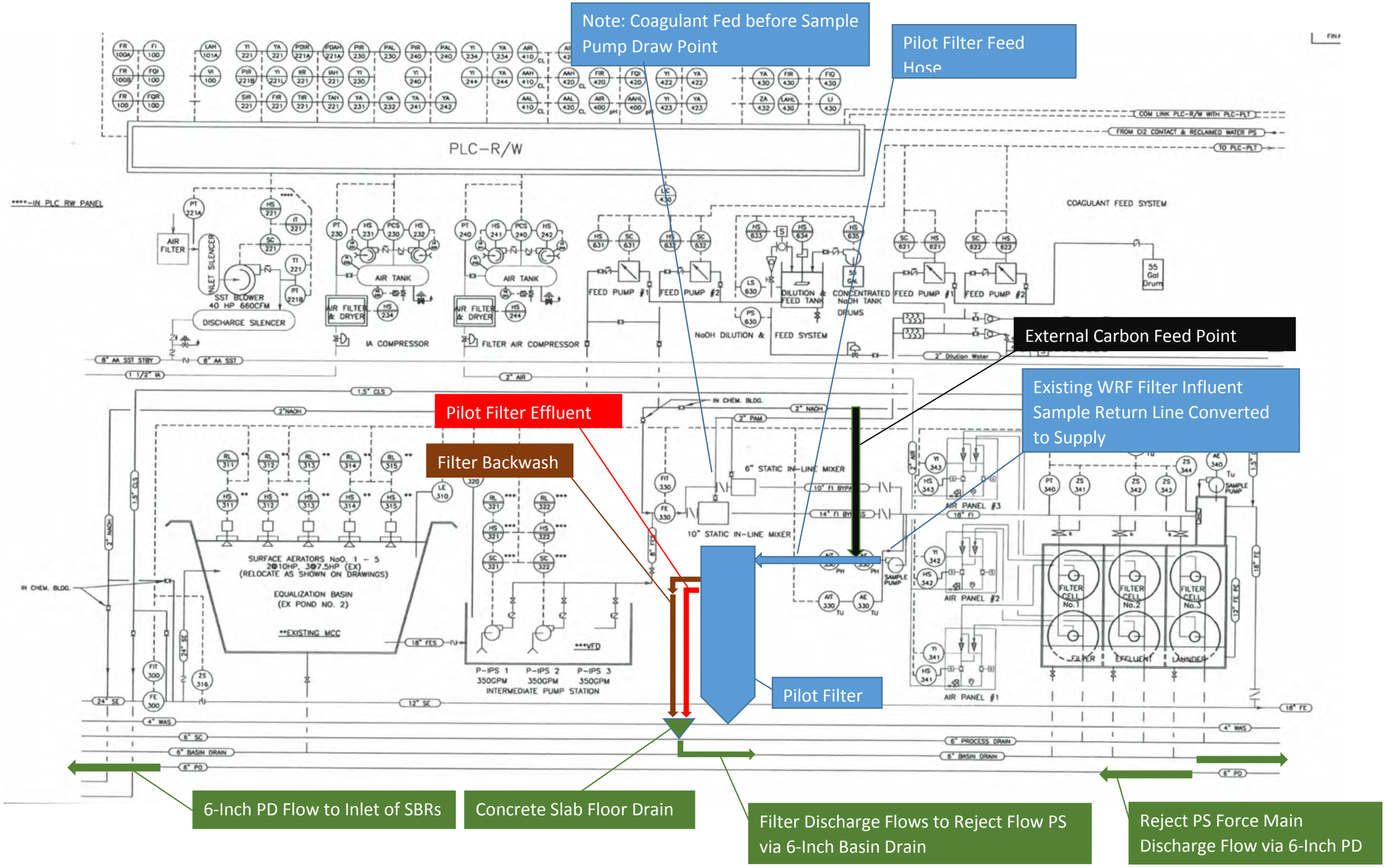


Figure 2 – Process Flow Diagram
(Note: Modified From Sheet PID-2 – Process and Instrumentation Diagram, Skillings and Connolly 1999 City of Yelm Water Reuse Project Record Drawings)

Figure 3 - City of Yelm WRF Denitrifying Filter Pilot Test - General Flow, Nitrogen and Carbon Dose Info

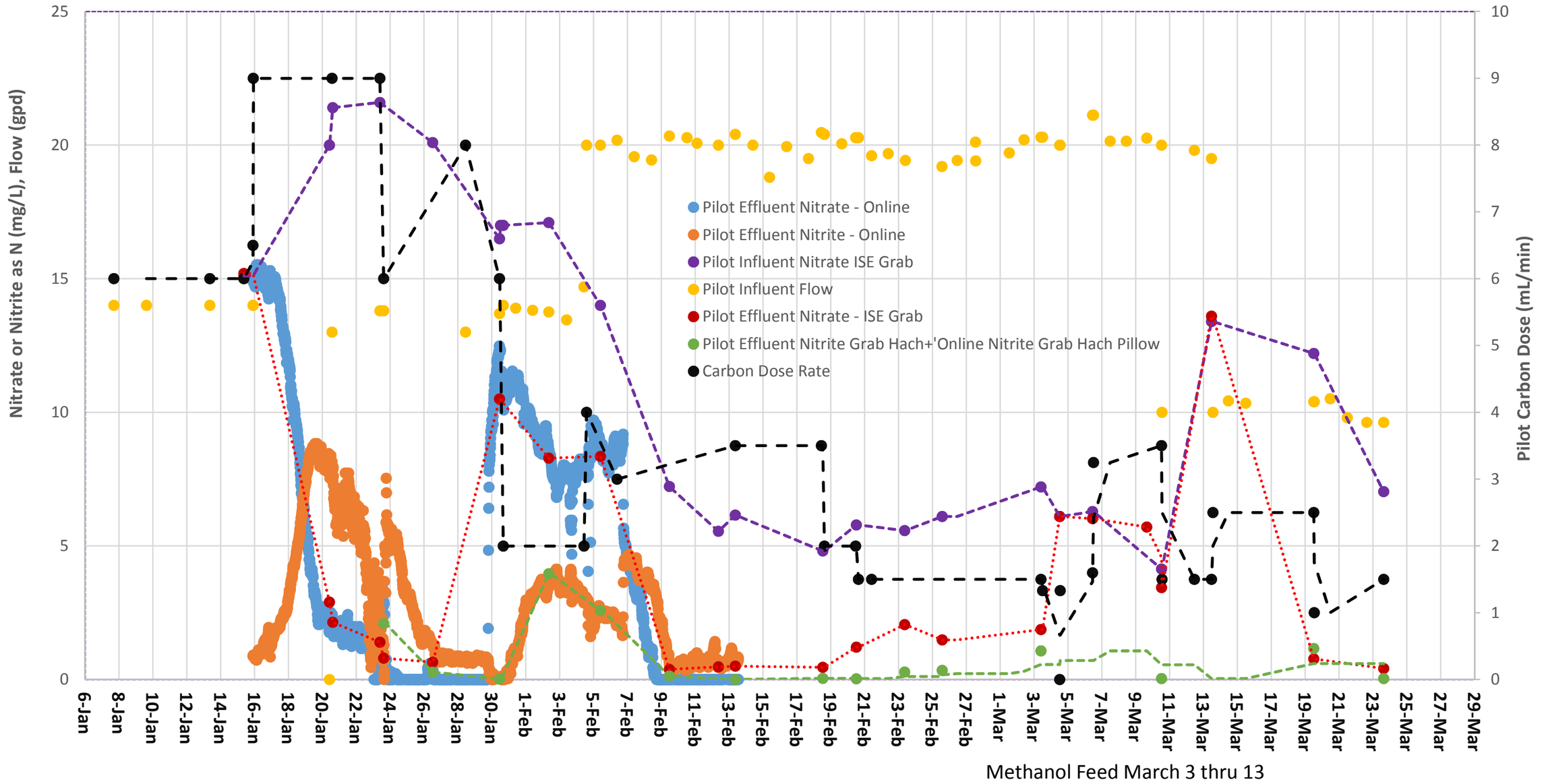


Figure 4 - City of Yelm WRF Denitrifying Filter Pilot Test - Turbidity Information

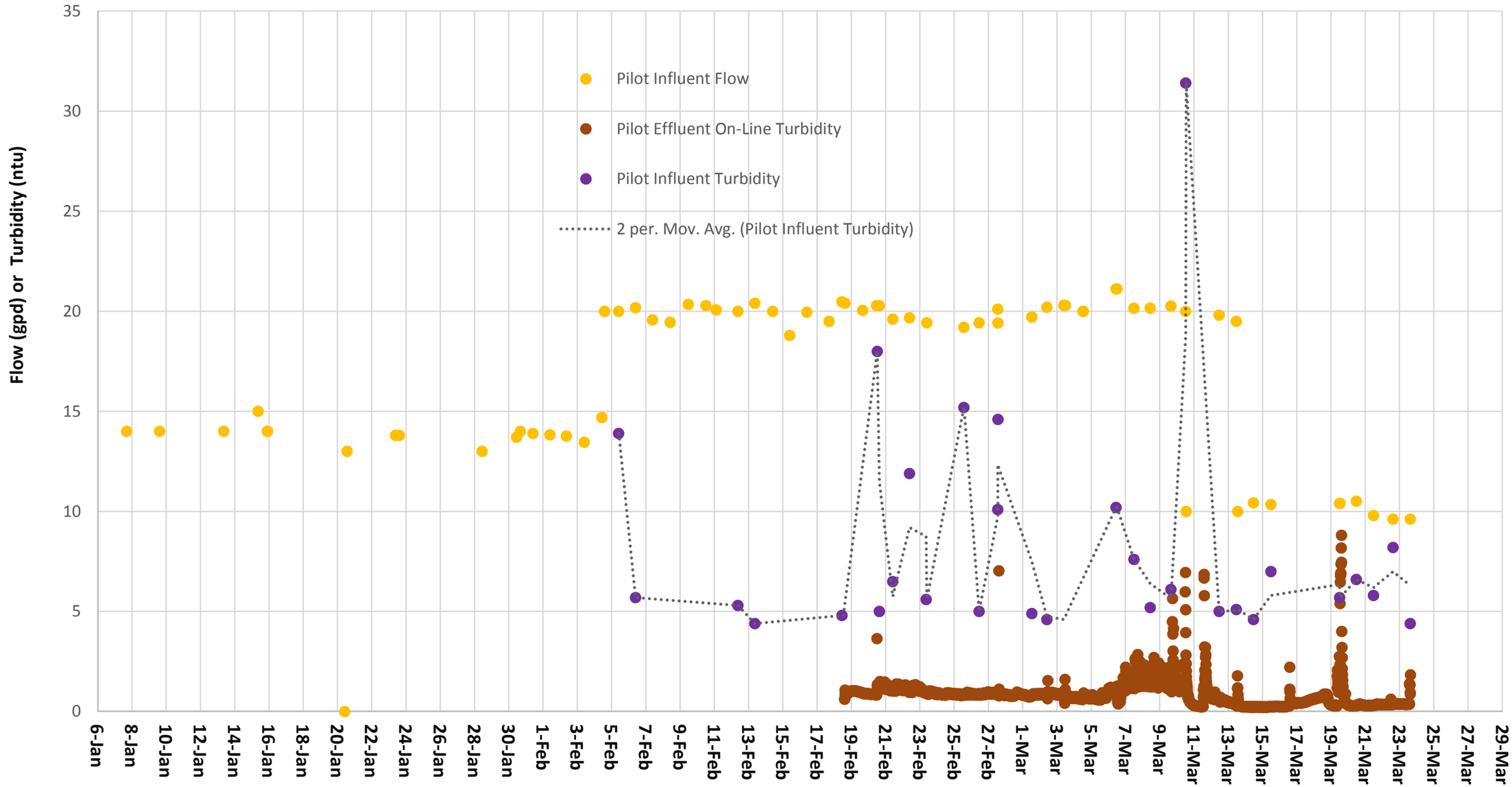


Figure 5 - City of Yelm WRF Denitrifying Filter Pilot Test - Pilot Effluent ORP, Dissolved Oxygen, and Temperature

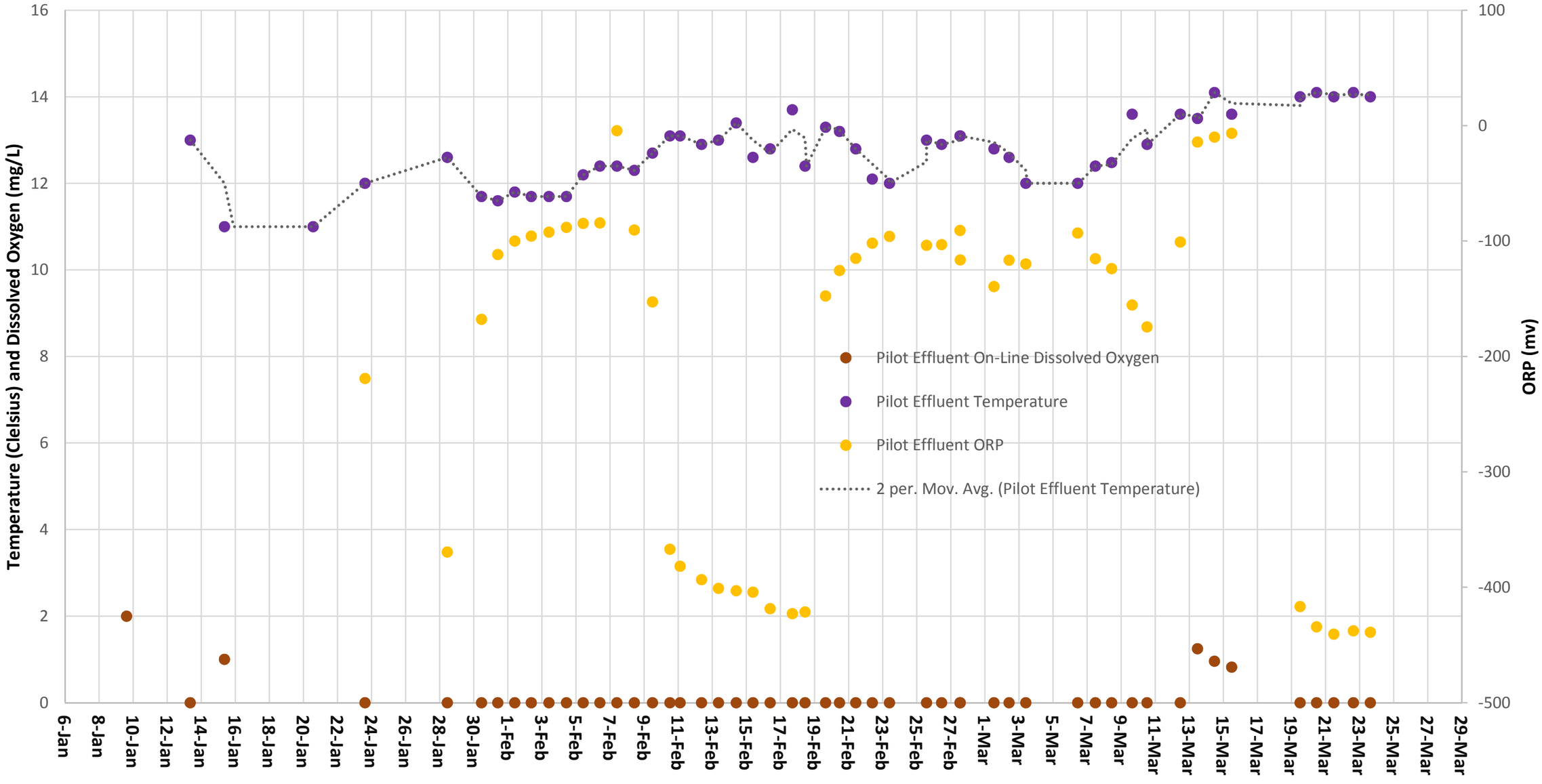
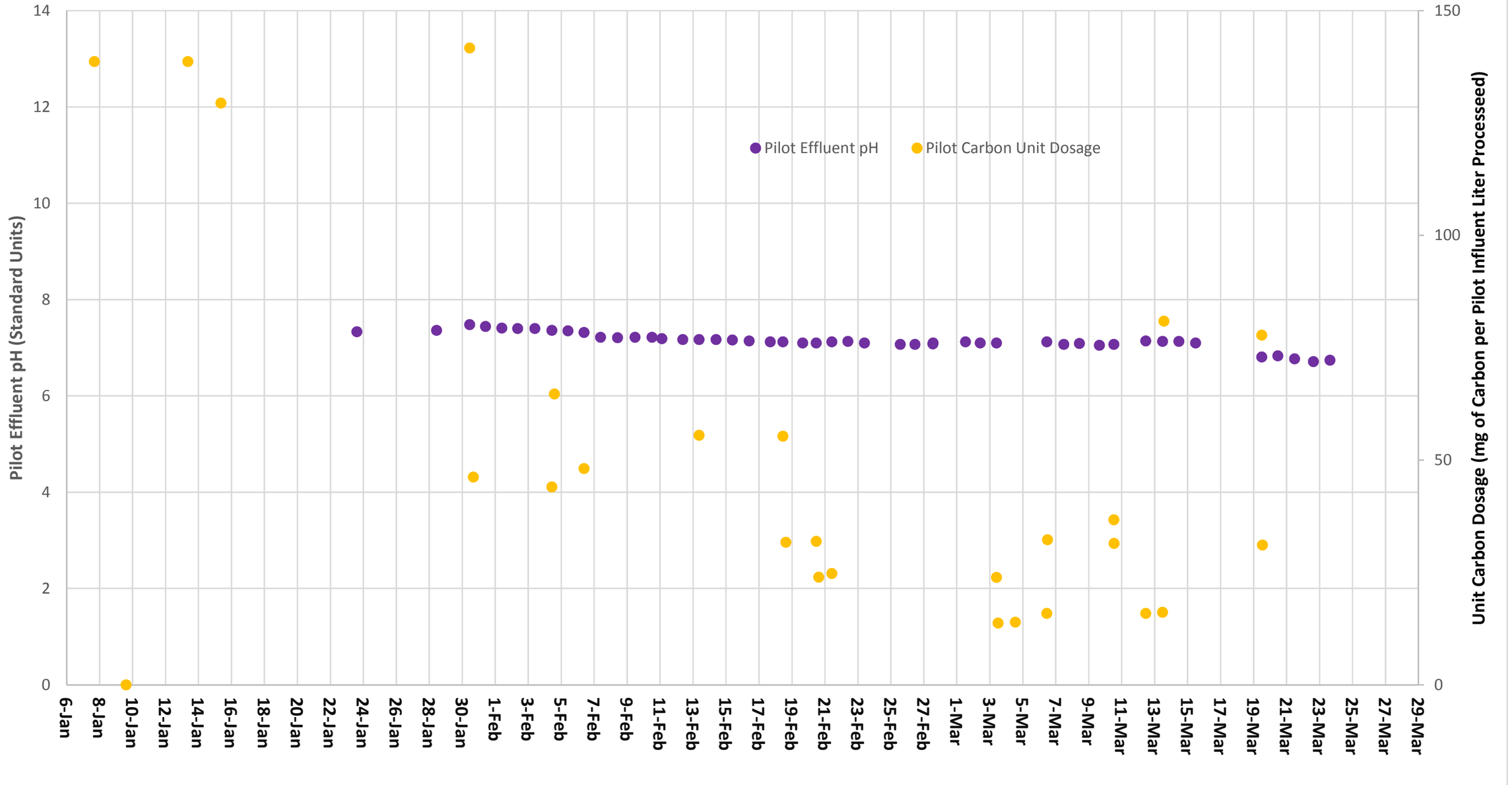


Figure 6 - City of Yelm WRF Dentrifying Filter Pilot Test - Pilot Unit Carbon Dosages and Effluent pH



Attachment B

MicroC 2000™ Product Information

MicroC 2000™

PRODUCT INFORMATION

MicroC 2000™ is a proprietary, non-hazardous, green chemical designed specifically for use as a carbon source for biological contaminant removal applications in water/wastewater treatment.

COST EFFECTIVENESS

- Best value among non-hazardous alternative carbon sources

NON-HAZARDOUS

- Eliminates flammability and toxicity concerns of traditional chemicals such as methanol
- Provides capital cost savings vs. installation of flammable liquid storage and feed system
- Non-hazardous product enable rapid and flexible deployment of carbon augmentation solutions

PERFORMANCE ADVANTAGES

- Rapid start-up/acclimation
- Superior cold weather performance

ENVIRONMENTALLY SUSTAINABLE

- Derived from abundant, renewable resources produced in the United States vs. largely imported fossil-fuel derived carbon sources (methanol)
- USDA BioPreferred designation

CONSISTENT AND SUPERIOR QUALITY

- Rigorous end to end quality control program
- Consistent Chemical Oxygen Demand (COD) values
- No product degradation during long-term storage

VALIDATED PERFORMANCE

- MicroC™ products in use at over 425 plants in North America
- Performance validated by leading equipment/process suppliers, consulting engineers and academic institutions
- Full scale, documented performance validation for:
  - Nitrate removal
  - Enhanced Biological Phosphorus Removal (EBPR)
  - Metals removal
  - BOD augmentation
  - Perchlorate removal
  - Fixed film biological processes (i.e. denitrification filters)
  - Startup/acclimation dynamics
  - Cold weather performance
- Denitrification rates and kinetic parameters determined by Northeastern University

TECHNICAL SERVICES

- Application guidance from team of BNR/contaminant removal experts
- Dedicated support to ensure achievement of contaminant removal goals

SUPPLY CHAIN EXPERIENCE

- 11 nationwide MicroC™ manufacturing facilities
- Over 80 million pounds of MicroC™ products produced and delivered
- Over 14,000 drums and totes packaged and delivered
- Over 7,000 customer deliveries completed

PACKAGING

- Bulk (1000-4500 gallon)*
- 270-gallon IBC/tote
- 55-gallon drum
- 30-gallon drum
- 5-gallon pail

*Maximum volume 4800 gallons in some markets

Environmental Operating Solutions

TECHNICAL SPECIFICATIONS

PROPERTY	SPECIFICATIONS	TYPICAL VALUE	TEST METHOD
Specific Gravity at 20°C	1.215-1.235	1.225	ASTM D 1298-85
Bulk Density (lbs/gal)	10.13-10.30	10.22	ASTM D 1298-85
pH	4.0, min	5.5	SM 4500 H B
Viscosity (cPs) at 20°C	80, max	45	ASTM D 2196-86
Flash Point	None to Boil	None to Boil	ASTM D 93
Solubility	99%, min	100%	ASTM E1148
VOC Concentration	0%, max	0%	EPA 8260B
Freezing Point (°C)	-18, max	-35	ASTM D1177-07
COD (mg/L)	1,000,000, min	1,060,000	HACH 8000
Methanol Content	0.1%, max	0.01%	AOCS Ba 13-67 (modified)
Fatty Acid Content	1.0%, max	0.3%	AOCS Ca 5b-71

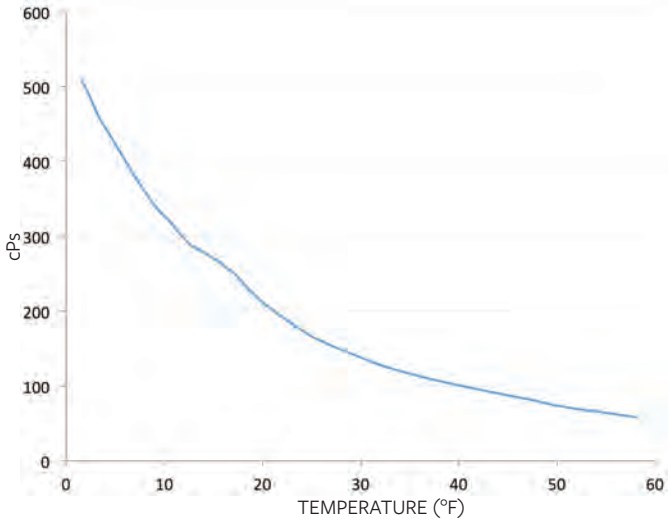
BATCH TEST RESULTS

	NITRATE UPTAKE	HIGH F:M
SDNRmax (mgN/gVSS/hr)	⬢	
COD:N	⬢	⬢
Yobs (gVSS/gCOD)	⬢	⬢
Ks (mg COD/L)	⬢	
µmax (1/day)		⬢
Theta for SDNR	⬢	
Theta for µmax		⬢

Values available for 10°C and 20°C

Denitrification Rates and Kinetics The parameters listed in this table were determined through extensive batch testing at Northeastern University's Department of Civil and Environmental Engineering (Boston, MA). EOSi has experience applying these parameters within mathematical simulators (BioWin, GPS-X™, etc.) to simulate product performance in a variety of operating conditions. Please contact EOSi for parameter values and application guidance.

TEMPERATURE / VISCOSITY RELATIONSHIP



Note: Although product freezes below 0°F, viscosity analyses stopped at 0°F due to practical considerations

USDA CERTIFIED BIOBASED PRODUCT

Attachment C

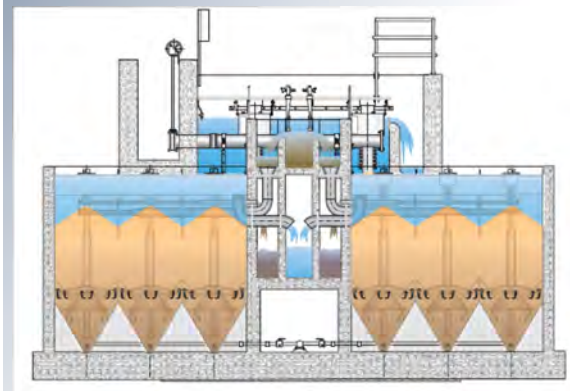
Pilot Filter Rental Agreement and Operating Manual

WesTech
an employee-owned company

Installation, Operation, and Maintenance Manual

For:
SuperSands Pilot Unit

Equipment:
One (1) SS2 SuperSand™
Continuous Backwash Filters



Furnished by:
WesTech Engineering, Inc.
Salt Lake City, Utah
WesTech Project Number:
R184
February 2012
Revision 0

Thank you for the confidence you have shown in our company and product.

We are sure that your SuperSand Filters will serve you well.

Please, study this manual thoroughly before installing and starting-up your SuperSand plant.

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PREFACE

Thank you for the confidence you have shown our company and product. We are sure that your SuperSand™ Filters will serve you well.

Please, study this manual thoroughly before installing and starting up your SuperSand™ plant.

WESTECH AN EMPLOYEE OWNED COMPANY

OPERATION AND MAINTENANCE MANUAL

FUNCTIONAL DESCRIPTION

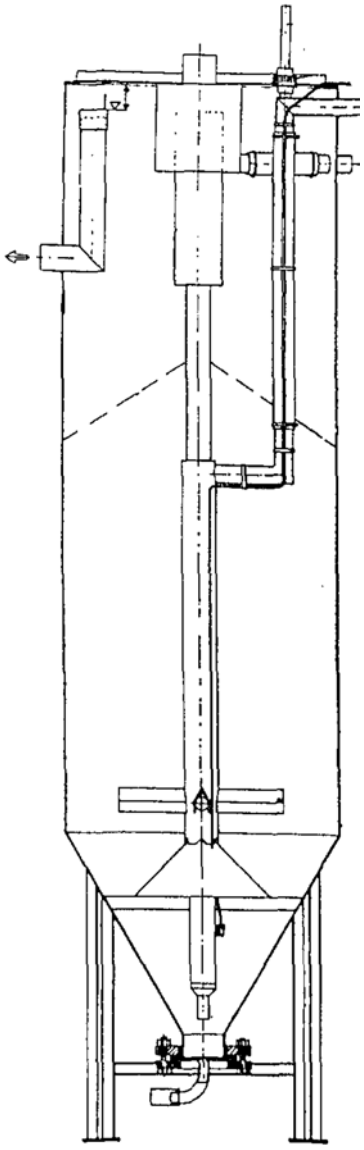
FUNCTIONAL DESCRIPTION

GENERAL

The SuperSand™ Filter is a continuously operating filter, i.e. the filter does not have to be taken out of operation for backwashing or cleaning.

Incoming water is filtered upstream through the sand bed while the sand is moving downwards.

Simultaneously with the filtration process, fouled sand is cleaned in a sand washer and the suspended solids are discharged with the wash water.



FILTRATION PROCESS

Before the incoming water is fed to the filter plant it must be pretreated by screening or similar equipment in order to remove coarse foreign objects that otherwise might disturb the motion of the sand in the filter, or block pipes and valves.

Each filter must be equipped with an isolation valve mounted on the inlet flange or piping.

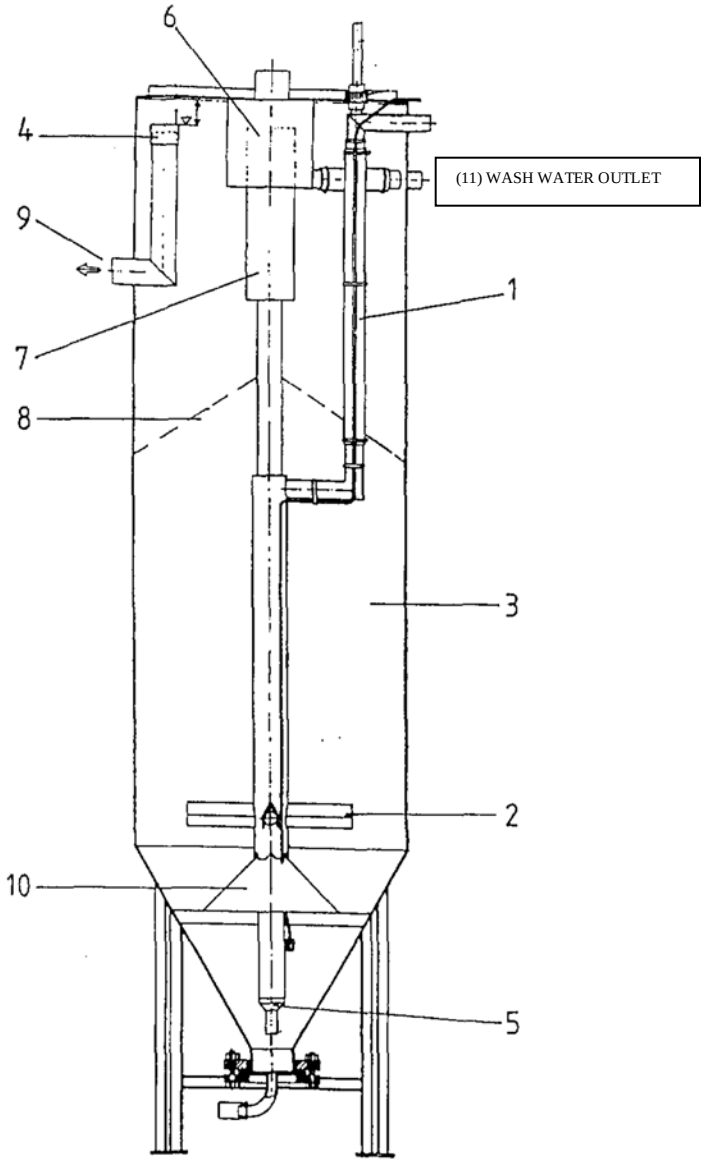
The water is fed into the filter by the inlet pipe (1) and distribution arms (2). The water rises through the downwardly moving sand bed (3) and the filtrated water is discharged via an overflow weir (4) and the outlet (9).

The fouled sand is lifted by the air lift pump (5) to the collection vessel (6) in the upper part of the filter. The sand then falls down into the sand washer (7) where it is rinsed in counter current flow with a small amount of filtrate.

The cleaned sand falls back over the surface of the filter bed (8) and takes part in the filtration process again.

The wash water is discharged through the wash water outlet (11).

The sand distribution cone (10) is designed to create an even motion of sand over the filtration area.



AIR LIFT PUMP

The air lift pump is vertically placed in the protecting tube (1) which will fix the pump in its correct position. The upper part is connected to the sand washer at top of the filter. The inlet part (6) of the pump is located close to the bottom of the filter.

Compressed air is fed from the Air Control Panel into the pump through the solenoid valve (2), pipe (3), and the injection chamber (5).

When compressed air is fed into the air lift pump, a mixture of air, sand and water forms inside the air lift pump.

The column will move upwards because it has a lower density than the sand and water mixture outside the pump.

A mixture of sand, water and air flows out from the air lift pump. The air from the pump is ventilated at the upper part of the splash hood.

When the sand leaves the pump outlet its velocity decreases immediately and sand will start to fall down through the sand washer (9).

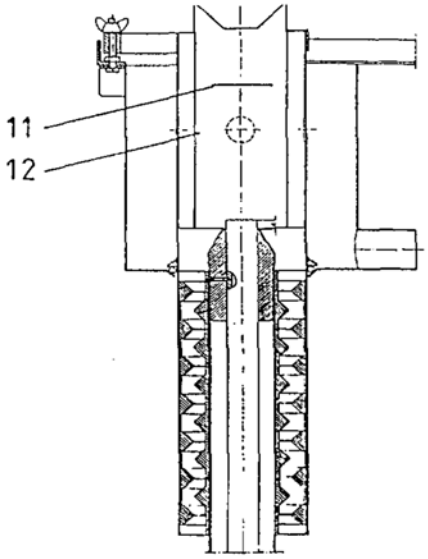
Solids having a lower density than the sand grains will follow the wash water into the collecting vessel (7) and then out through the wash water outlet pipe (10). The amount of sand pumped by the air lift pump will on first hand be regulated by the volume of air into the air lift pump. The headloss caused by the incoming water also has an influence on the pumped amount of sand.

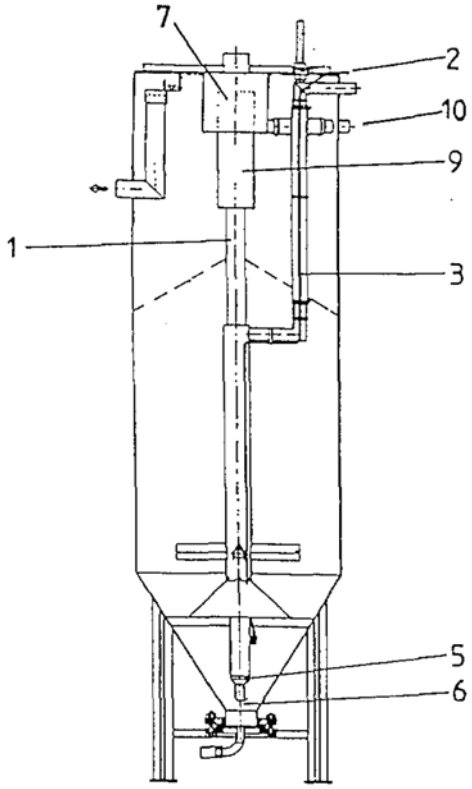
To prevent sand coming out from the splash hood (12) there is a splash plate (11) on top.

NOTE:

Depending on if the filter is made of stainless steel or GRP the air lift pump is different manufactured.

Look at the assembly drawings of the filter and air lift pump.





SAND WASHER

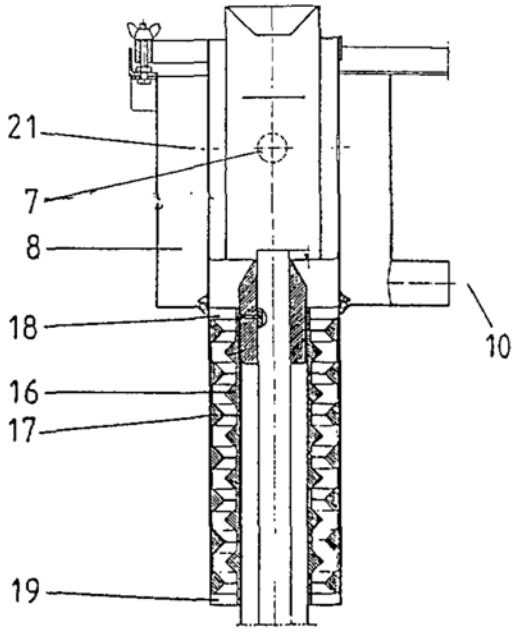
The lower part of the sand washer consists of two pipes containing rings (16, 17) placed to create a labyrinth. The outer pipe is centralized and locked by the lock rings (18, 19) in each end.

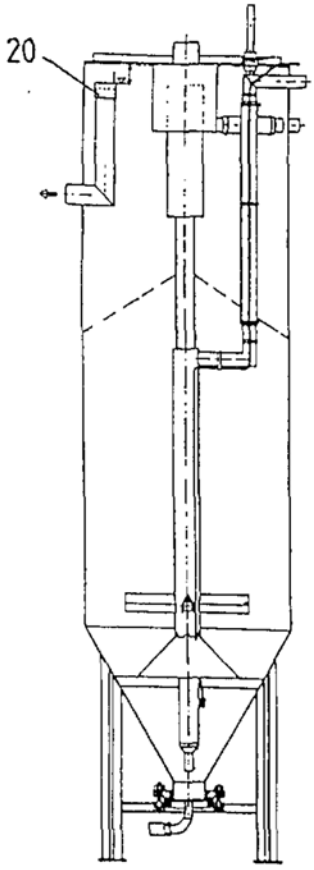
As the sand falls down through the labyrinth the sand grains are subjected to a whirling movement and meet simultaneously a counter flow of clean water. Solids on the sand grains will be flushed away and follow the rising wash water flow.

The movement of counter flowing water is created by the difference in levels between the filtrate surface in the filter tank and the wash water surface inside the tube (21).

The level difference is achieved by adjusting of the weir (20).

This level difference will cause a small portion of filtrate to rise upwards through the sand washer. The wash water flows through the holes (7) into the collecting vessel (8) and is then discharged through the wash water outlet pipe (10). The wash water flow is also influenced by the amount of sand lifted by the air lift pump.





WESTECH

AN EMPLOYEE OWNED COMPANY

INSTALLATION

WESTECH ENGINEERING, INC.3625 SOUTH WEST TEMPLE, SALT LAKE CITY, UTAH 84115

INSTALLATION

ERECTION

The SuperSand™ Filter is delivered secured on pallets or on a wooden cradle with all the internal parts mounted.
Erect the filter on a solid horizontal foundation.

NOTE: The transport locking of internal parts is not to be removed until the filter is in upright position.
Check that the filter is vertical with a plumb line or similar. If the filter is not vertical, adjust with steel or PVC plates.

ASSEMBLY OF DEAERATION AND HEADLOSS MEASUREMENT DEVICES

1. Connect the reject pipe to the 1½" standard flange using the gasket and fasteners provided.
2. Now connect the Deaeration Tube to the threaded connection on the influent piping. Be sure to place the other end of the pipe inside of the reject pipe. Next connect the tubing, already connected to the inside of the filter, to the Deaeration Tube use the hose clamp to connect as shown on Dwg D110.
3. Connect the pressure drop tube to the Deaeration Tube and to the influent pipe, also use the tube clamp to connect the pressure drop tube to the deaeration tube as shown on D110.

PIPE CONNECTIONS:
Location #5 Incoming water
Location #6 Filtered water
Location #7 Discharge of wash water

CONNECTIONS OF COMPRESSED AIR HOSES

Connect the ½" tubing supplied to the ball valve on the rim of the tank and also to the ½" connection on the air control panel.

INSTALL FLOAT SWITCH AND REJECT WEIR

The float switch is on the control skid attached to the reject weir. Take the float switch/weir assembly and attach it to the reject pipe inside the filter (3)

INSTALL DRAIN VALVE

Mount the bottom flange (8), drain valve (9), bottom screen, and gasket using provided fasteners, also shown on D110

Note: The internals were secured for transport using a bolt and plate. Remove these items to install drain valve assembly.

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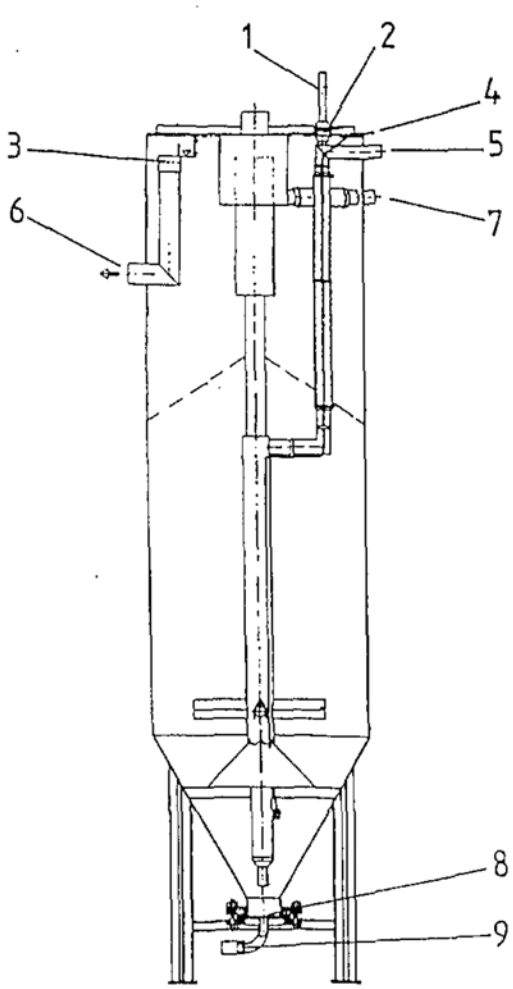

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OPERATION

OPERATION

START-UP PROCEDURE

Note! Before the start up procedure, make sure that all construction debris are removed from the pipelines.

The capacity of the filter is dependant upon the characteristics of the incoming water, type and concentration of suspended solids and degree of purity that is required in the filtered water.

The first time a filter is filled with water, it is important to use a water supply as clean as possible. **Dirty process water is not recommended** as this can cause clogging of the sand bed because the air lift pump does not operate properly until the filter is filled with water.

Check that the inlet valve to the filter and air valve (ball valve) on the top of the filter are open.

The amount of pumped sand is to be set with the air flow meter which is located in the control cabinet.

Instruction of suitable setting on the air flow meter is given on page 10. "RECOMMENDED OPERATING SETTINGS".

For control and adjustments, see page 7 "SAND AND WASH WATER FLOW RATE".

When the air lift pump is in normal operation the flow of wash water shall be checked and adjusted to 1.5 -2 times the volume of sand pumped by the air lift pump. As mentioned earlier the flow of wash water is also influenced by the amount of sand lifted by the air lift pump (page 4).

Final adjustment of the wash water is determined by the difference in levels between filtrate and wash water obtained by adjusting the weir at the top of the sand filter.

After start of the filter and when sand pumping and wash water flow rate are adjusted the water level in the headloss measuring pipe shall be read and noted. This is the zero value that shall be used for the basis or zero value of the headloss change.

Note the headloss over the filter bed after 30 minutes of operation and then once every hour. If the sand flow is sufficient, the headloss will stabilize within approx. 4 hours. This level should be less than 1.5 times the "zero" value. Write down the headloss value on the page 10 "RECOMMENDED OPERATION SETTINGS" .

If the quality of the filtrate is poor although the headloss is constant, the wash water flow rate must be increased. Adjust the reject weir (1) so that the difference in level between filtrate and wash water increases.

As mentioned before, wash water flow through the sand washer is not only influenced by the difference of level, but also of the sand flow. If the sand flow stops the flow of wash water will notably increase because of decreased amount of sand in the washer labyrinth.

SAND AND WASH WATER FLOW RATE

HOW TO USE THE MEASURING ROD

By using the measuring rod (1), with the Inch/Centimeter graded scale, the velocity of the sinking sand bed can be determined. When the sand is moving downwards, the measuring rod will follow. Use a stop watch and calculate the sinking velocity of the sand.

1. Adjust the air flow meter in the control cabinet for compressed air to its recommended setting. See page "Recommended settings", found on page 10.
Note: a high headloss over the filter bed will increase the airlift pump capacity.

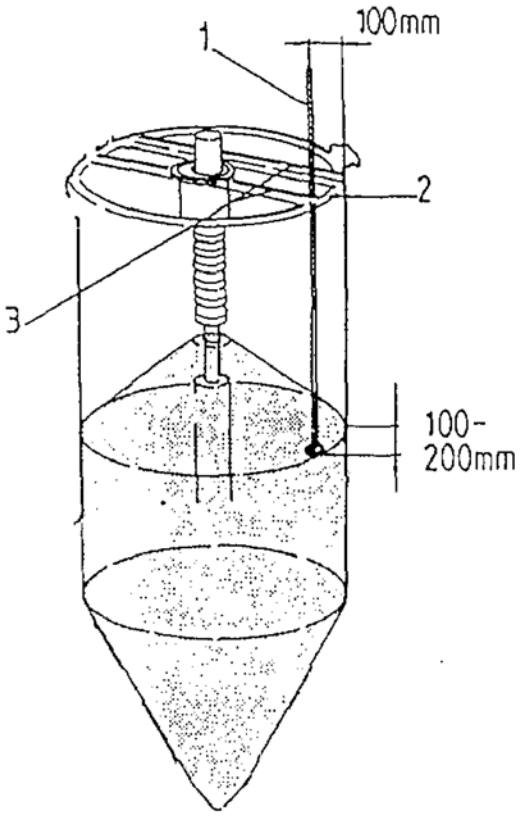
2. Push the measuring rod (1) with the plate end downwards approx. 2" (50 mm) from the wall and approx. 4-8" (100-200 mm) down into the sand bed. If the measuring rod sinks 5/16" (10 mm) during 75-100 seconds at 3 measuring points, the sand is moving downwards with a velocity of ¼-5/16" (6-8 mm)/minute. The mean value from the measuring points can for instance be approximately ¼" (7 mm)/min.

Example:

$$\frac{10 \text{ mm} \times 60 \text{ sec}}{75 \text{ sec}} = 8 \text{ mm/min}$$

Use the flange of the tank (2) or the beams (3) as reference points when measuring the sand sinking velocity. The water surface is not suitable as reference point as it may vary due to flow changes.
Use at least 3 measuring points around the periphery.
Example: With a filter area of 3.2ft2 and a sinking velocity of 5/16" (8 mm)/min the volume of the sand lifted by the air lift pump will be 0.3 x 8 = 2.4 liters of sand/min.

If the difference in sinking velocity between the measuring points is big or if the sand is standing still at any of the measuring points action must be taken to start the sand motion again. See section "Trouble shooting", see page 11 of this manual.



HOW TO ADJUST THE WASH WATER FLOW RATE

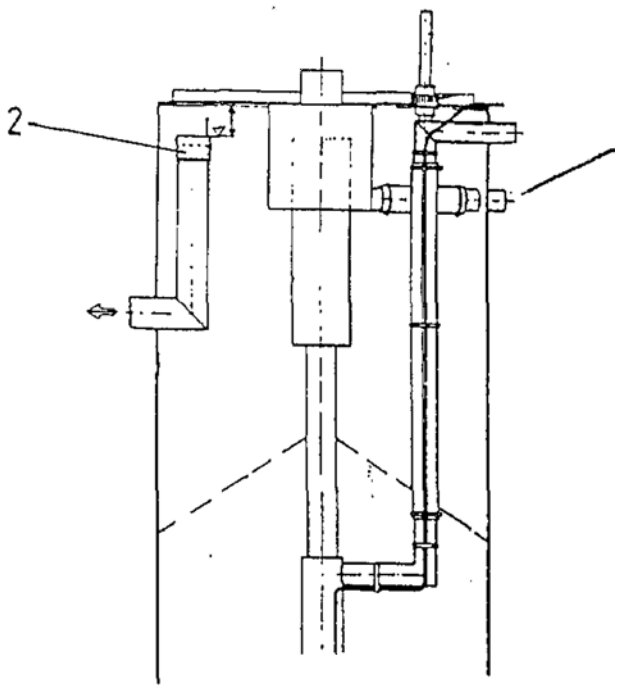
The wash water flow rate shall be 1.5 - 2 times the sand flow rate. See "HOW TO USE THE MEASURING ROD" page 7.

Ex. Filter area: 3.2ft2 (0.3 m²)
Sinking velocity: 5/16' (8mm) /minute
Sand volume/minute:
3.2ft2 x 5/16" = 0.83ft3/ min -or-
0.3m2 x 8mm= 2.4 liters/min.

In this case the wash water flow rate should be between 3.6-4.8 L/min.
Example:
2.4 sand/min x 1.5 = 3.6 L/min
2.4 sand/min x 2 = 4.8 L/min

Measure the wash water flow by using a bucket at the wash water outlet (1).

Adjust the wanted wash water flow by using the adjustable weir (2).
Upwards - higher flow
Downwards - lower flow



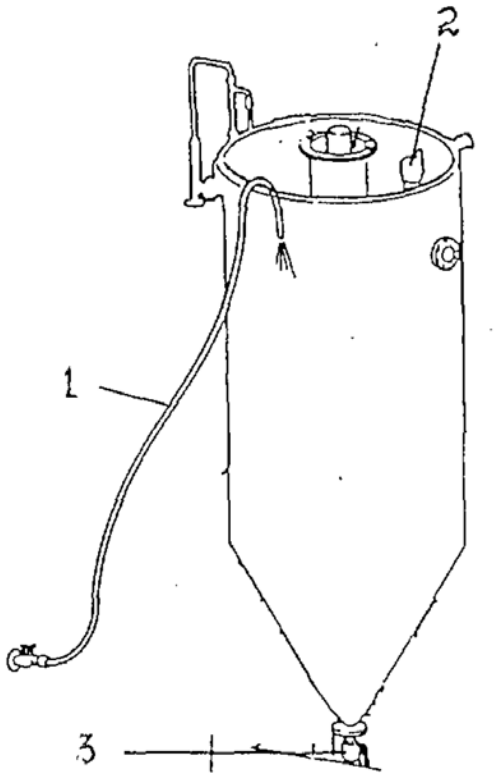
TAKING FILTER OUT OF OPERATION FOR LONGER PERIODS OF TIME

When the filter is out of operation for longer periods of time, there is a risk of bacteria growth and/or clogging.

Depending on the application the filter sand must be washed. Normally if there is a risk of bacteria growth the filter sand has to be washed when the "out of operation periods" are longer than 2-7 days.

At shut-off, the following cleaning procedure shall be followed:

1. Solids deposited in the upper part of the filter tank and in the sand washer should be removed with a brush.
2. Shut off the feed inlet valve for process water and let the air to the air lift pump be on.
3. WASH THE SAND
   For this a supply of clean water (1) is necessary. The clean water is flushed into the filter tank from above. The flow rate should be high enough that the water level touches the upper edge of the weir (2). Run the air lift pump as before the shut down. This allows the sand to be washed by the ordinary washing system. Continue operating until all the sand in the filter has passed through the sand washer for at least one cleaning cycle. This corresponds to a running time of about 5 hours at a sand pumping rate of 2.4 L/min in a DST 3.2ft2 filter. The clean water supply is then shut off and the air-lift pump is stopped.
4. DISINFECTION
   Add 32oz. (1 liter) 12 % sodium hypochlorite solution per 35 Cubic Feet (1 cubic meter) of filter volume. The liquid is poured into the filter from above. Mix the hypo-chlorite solution carefully with the water that is standing above the sand bed in the filter tank. Run the air-lift pump in accordance with number 3 for at least 5 hours without taking out any wash water.
5. RINSING
   Drain the water containing hypo-chlorite from the filter tank through the bottom valve (3). In order to avoid corrosion, repeat procedure according to point 3.1 "Wash the sand".
6. DRAINING THE FILTER
   When all the sand has been washed clean, all of the water should be drained out of the filter. Fill the filter to normal water level with clean water and see page 6.



RECOMMENDED OPERATING SETTINGS

Due to process differences which can occur from one application to another, optimal settings vary greatly. Therefore initially operation settings are only given to put the filter into operation. Then the filter has to be adjusted for your specific application. See "Sand and wash water flow rate", pages 7 and 8.

When the start-up procedure and the adjustments are finished write, down the values under the second column titled: NORMAL OPERATION.

	INITIALLY	**NORMAL OPERATION**
Air pressure after reducing valve	25-30 psi	25-30psi
Air flow to air lift pump	.4-.6 scfm	…….scfm
Vertical sand velocity	1/4 - 5/16”/min	……..inches/min
Which gives a sand flow rate of	.4 – 6gpm	……...gpm
Wash water flow rate	1.0 – 1.5gpm	……gpm
Headloss		……ftWC (feet Water Column)

NOTE: The sand and wash water flow rate can be fine tuned after a couple of hours of normal operation. Operator experience and monitoring of effluent water quality will help optimize the settings above.

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TROUBLE SHOOTING

WESTECH ENGINEERING, INC.3625 SOUTH WEST TEMPLE, SALT LAKE CITY, UTAH 84115

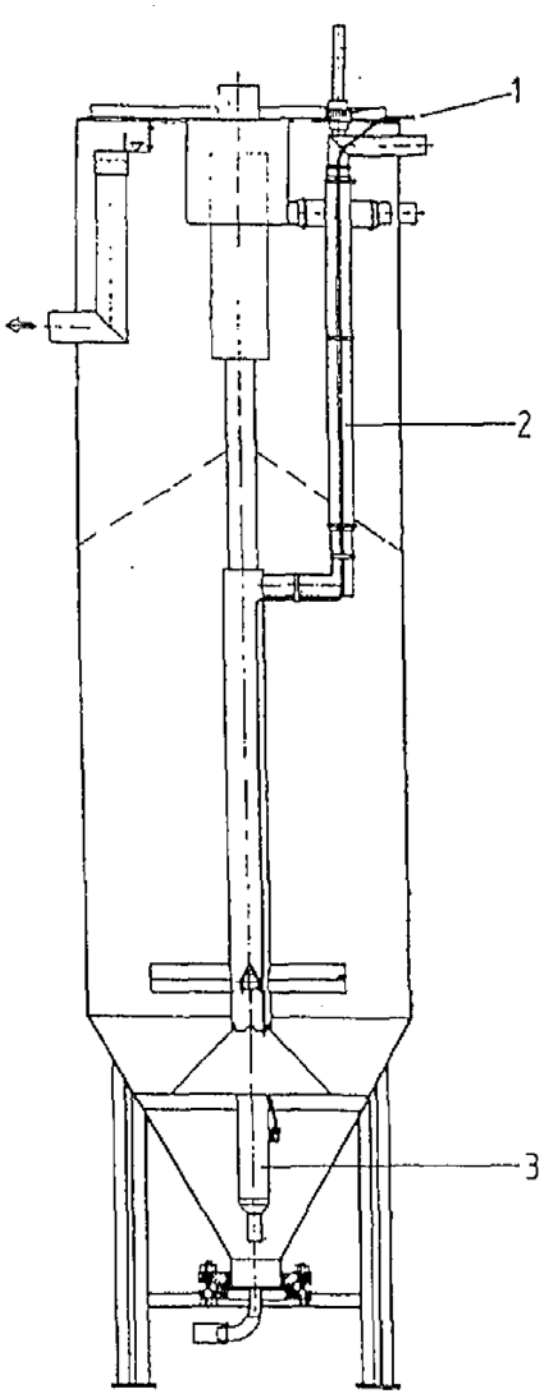
TROUBLE SHOOTING

THE AIR LIFT PUMP DOES NOT LIFT A SUFFICIENT AMOUNT OF SAND OR DOES NOT WORK AT ALL.

THE AIR FLOW METER INDICATES TOO LOW OR NO AIR FLOW AT ALL.

1. Check that the air supply to the control cabinet is normal.
2. If that is the case, check step-by-step that the compressed air hose and the connection from the control cabinet to the connection (1) are free from defects. If air is blowing out of the hose at pos.1 and the flow meter is showing normal air flow rate, either the compressed air hose/pipe (2) to the air injection chamber (3) or the perforated plate in the air injection chamber may be plugged. Shut off the operation of the filter.
3. If the air chamber is plugged (which may occur if there is carbonate precipitates in the process water) these can be removed by cleaning the air injection in chamber with hydrochloric acid.
4. Take out the sand and the internal parts and then dismount the pump and clean it.

NOTE: Use protective equipment when handling hydrochloric acid. Rinse with water and check with compressed air that the air injection chamber is free from layer of carbonate.

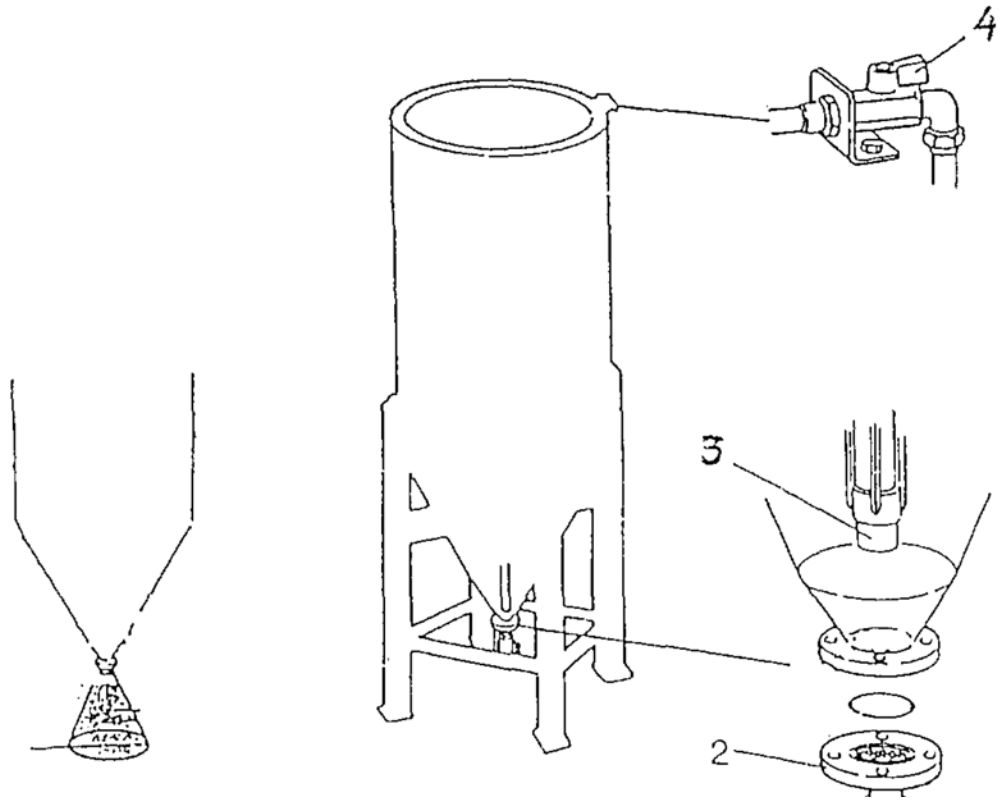


FOREIGN OBJECTS IN THE FILTER

If a foreign object (tools, rags etc.) has fallen into the filter it will sink together with the sand all the way down to the lower opening of the air lift pump where it will disturb the sand bed motion or plug the air lift pump opening. To fix this problem:

1. Take the filter out of operation.
2. Drain the water in the filter above the sand bed with the help of a siphon or a submersible pump. Drain the rest of the water through the bottom valve (1).
3. When the filter has been drained, the bottom flange/valve and screen (2) can be removed. The sand and hopefully the foreign object will now fall out through the flange opening. Dig out sand until the lower end of the air lift pump (3) can be felt with the hand. Check the suction opening of the air-lift pump and remove foreign objects if there are any. Clean the bottom flange's surface and try to get the sand stuck in order to create a sand vault. Reassemble the dismantled items.
   If the sand continues to fall out and it's impossible to achieve a clean surface on the flange and consequently the filter must be emptied and refilled.

NOTE:
If observing anything falling into the filter, immediately stop the sand pumping by closing the air valve (4) on the edge of the filter. Then drain the filter to the sand level and remove the object.



TURBID FILTRATE

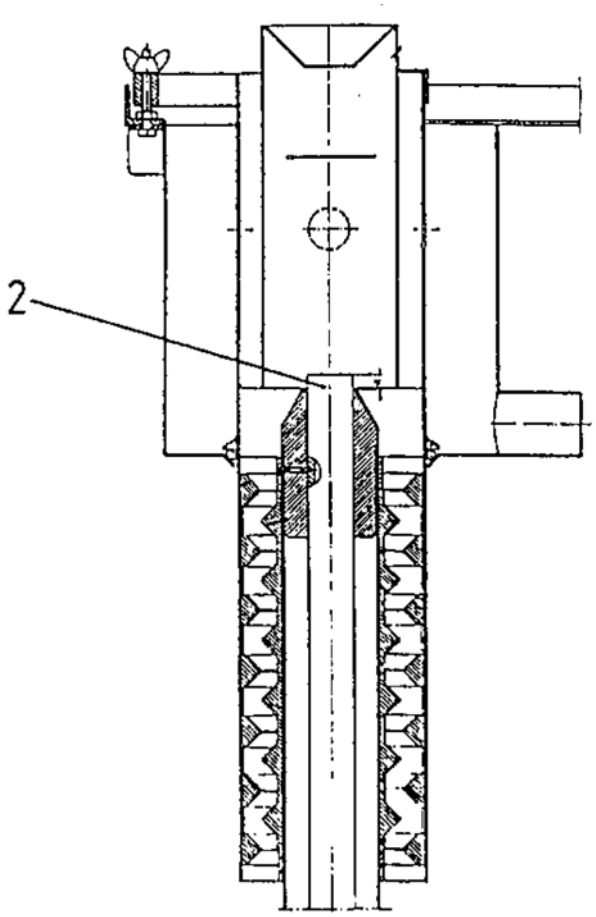
CHECKING	STEPS TO TAKE
Measure the sinking velocity of the sand and the flow of wash water	Adjust the reject weir and air flow rate
Is the incoming water flow too high?	Adjust to normal flow
Does incoming water contain too much suspended solids?	If possible, lower the flow of incoming water
Does the previous cleaning step function?	If not, it must of course be adjusted
Measure the sinking velocity of the sand at 3 points.	See page 12 Foreign Objects in the Filter
If the sand is not moving or partly still-standing in a section, but has a high flow in one part, a filter break-through may cause the turbid filtrate.	See page 15 Filter Break Through or Non-Moving Sand Bed

Unit with incorporated precipitation/flocculation treatment stage

CHECKING	STEPS TO TAKE
pH instrument and precipitation pH	Clean the electrode and calibrate the instrument. Adjust the precipitation pH if necessary.
Are the chemical concentration and dosage correct?	If “the correct amount and concentration” are closed but the results still poor, consider using other chemicals.

SAND WASHER CHOKED WITH SAND

At high loading rates and high concentration of suspended solids in the water, the sand bed may increase in volume. This might cause the sand level to rise up to the bottom opening of the sand washer until it is blocked, resulting in a reduced wash water flow.



If this happens, remove as much sand as the highest point of the sand bed is 2-4” (5-10 cm) lower than the bottom opening the sand washer when the filter is operating.

This can easily be done with a hose attached to the top opening of the air lift pump (2)

NOTE: If sand does not fall through the sand washer and if the bottom opening of the sand washer is not blocked with sand then the space between the labyrinth rings is blocked.

Clean the entire sand washer and labyrinth passage by water flushing. If any foreign object is stuck in between the labyrinth rings the object can be removed by dismantling the sand washer. Make sure that the object does not fall back into the filter tank again.

The best way to perform this operation is to remove the water down to the surface of the filter bed.

HEADLOSS OVER THE FILTER BED IS TOO HIGH

Incoming water flow is too high.
The filter must not be fed with more than the designed maximum flow rate.

The suspended solids content in the influent water is too high.
Check that the pretreatment equipment up-stream the sand filter is working normally.

If the influent water contains too high amount of suspended solids, the influent water must be decreased.

Dosage of precipitation chemicals is too high.
If too large a quantity of solids/floc are fed to the filter, the headloss will increase and this will result in a blocking of the sand bed.

FILTER BREAK-THROUGH OR THE SAND BED IS NOT MOVING

See page 9 " Wash the sand", instruction number 3. The sand washing shall continue until all the sand is moving in the filter bed.

"How to use the measuring rod"

If suggested actions for washing the sand have been repeated once or several times and the sand bed still does not move equally in all areas, the sand should be pumped out of the filter. The sand pumping can be carried out by using the air lift pump and the sand discharge hose as described on page 14 "Sand washer choked with sand"

NOTE: When emptying the filter from sand with the sand discharge hose, the filter unit must have a fresh water supply to keep up the water level in the filter. Otherwise the capacity of the air lift pump will decrease. Before the sand is reinstalled, the filter must be cleaned. Remove the bottom flange and empty the remaining sand from the filter.

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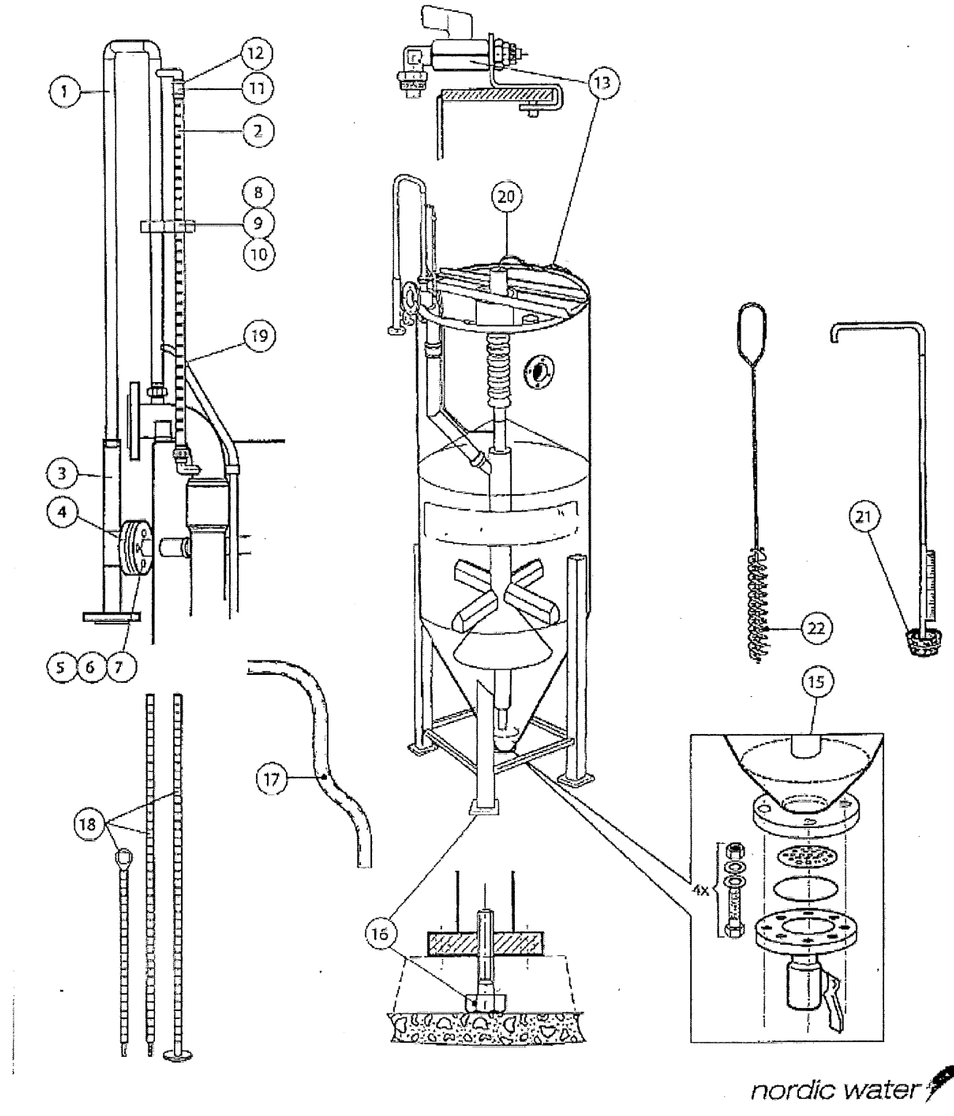
TECHNICAL DATA/ DRAWING LIST

WESTECH ENGINEERING, INC.3625 SOUTH WEST TEMPLE, SALT LAKE CITY, UTAH 84115



Part No.	Description	Qty
1	DEAERATION TUBE	1
2	PRESSURE DROP MEASURE TUBE	1
3	REJECT PIPE	1
4	GASKET	1
5	SCREWS M6S 16X60 A2	4
6	NUT M16 A2	4
7	WASHER 17X30X3 A2	8
8	FLAT BAR	1
9	TUBE CLAMP	1
10	TUBE CLAMP	1
11	FLEXIBLE TUBE	1
12	HOSE CLAMP	2
13	AIR VALVE	1
14	GASKET	
15	DRAIN VALVE ASSEMBLY	1
16	ADJSUTING SCREW M65 20X120 H FZV	4
17	SAND DISCHARGE PIPE	1
18	SAND MEASURING ROD	1
19	HOSE CLAMP	1
20	NYLON TUBE	1
21	RUBBER STOP	1
22	BRUSH	1

nordic water

REVISION	BY	CHKD	DATE	LTR

ASSEMBLY DRAWING

DESCRIPTION: SUPERSAND PILOT | SIZE: 36" DIA.

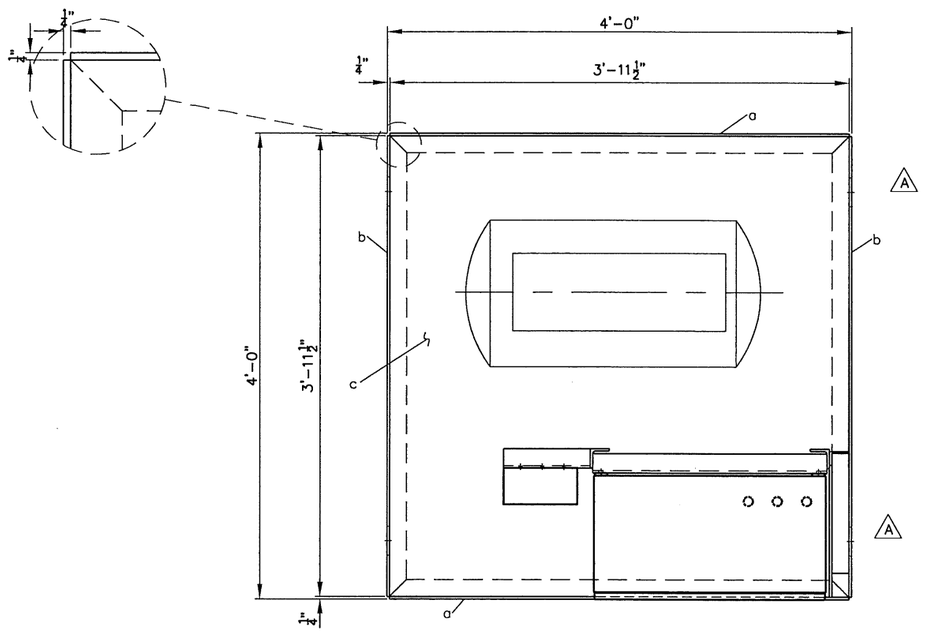
TYPE | SCALE: NONE | DATE: 2/10 | PROJ. BY: HMH

DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD
				NONE	2/10	HMH		

ALL COMPONENTS MUST BE FABRICATED AND MACHINED ACCORDING TO WESTECH STANDARD SPECIFICATION (DRAWING P24Z-024A), UNLESS SPECIFICALLY NOTED ON THIS DRAWING.

WESTECH

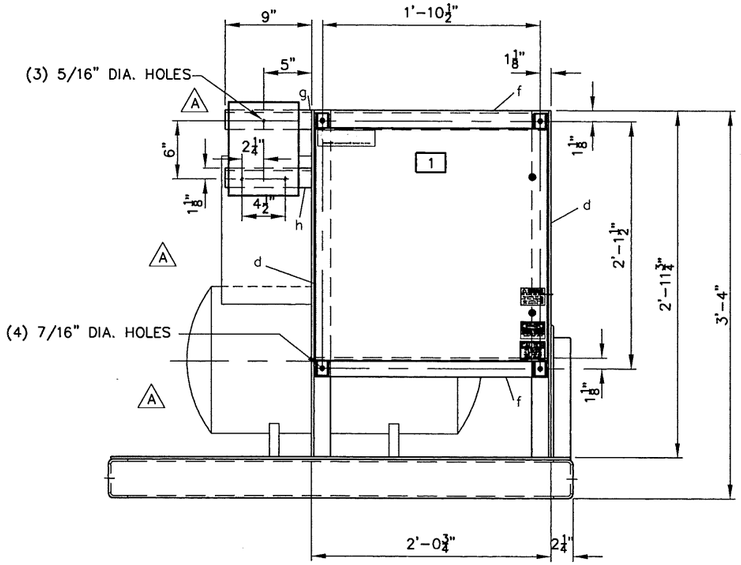
DRAWING NUMBER	PROJECT NUMBER	REV.
D110	R184	

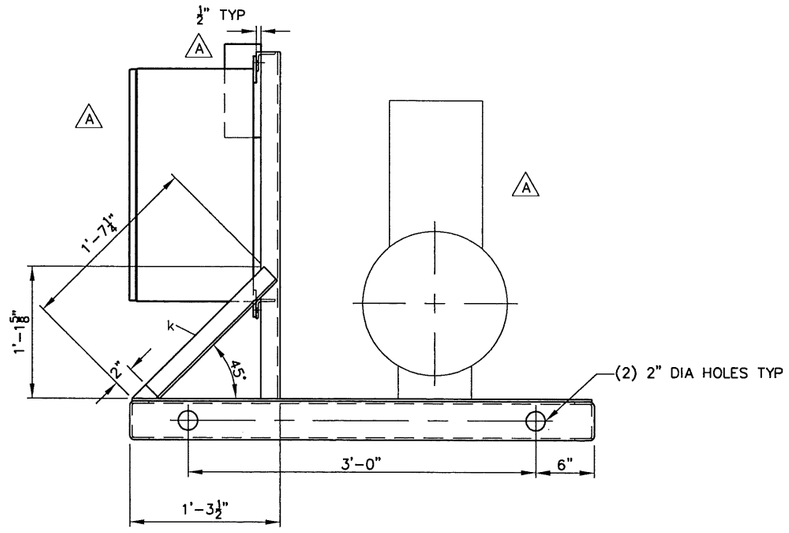


PIECE	QT'Y.	MAT'L.	DESCRIPTION/REMARKS	WT.
a	2	304 SS	PL 1/4 X 7" X 3'-11 1/2" BEND & MITER	48
b	2	304 SS	PL 1/4 X 7" X 3'-11 1/2" BEND & MITER	48
c	1	304 SS	PL 1/4 X 47 1/2" X 3'-11 1/2"	160
d	2	304 SS	L 2 X 2 X 1/4 X 2'-11 3/4"	20
f	2	304 SS	L 2 X 2 X 1/4 X 2'-0 1/4"	13
g	1	304 SS	L 2 X 2 X 1/4 X 0'-9"	3
h	1	304 SS	L 2 X 2 X 1/4 X 0'-9"	3
k	1	304 SS	L 2 X 2 X 1/4 X 1'-7 1/4" MITER	7

SKID COMPRESSOR

PART NO.: D123A
WEIGHT: 302 LBS.
QUANTITY: (1)





NOTES:
1. AFFIX PARTS LIST ITEM NO. TAG AS PER DWG WAST0001.
2. WORK WITH FABRICATION AREA CLEANING DWG A60B-001A.
3. ALL WELDS TO BE CONTINUOUS 3/16 FILLET OR BUTT WELDS, UNLESS OTHERWISE NOTED.
4. SHOP TRIAL ASSEMBLE TO MATING PARTS.

REVISION	TAG	BY	CHKD	DATE	LTR
ADDED ELECTRICAL PANEL, SWITCH, AND COMPRESSOR				02/13/12	A

SKID COMPRESSOR
DESCRIPTION

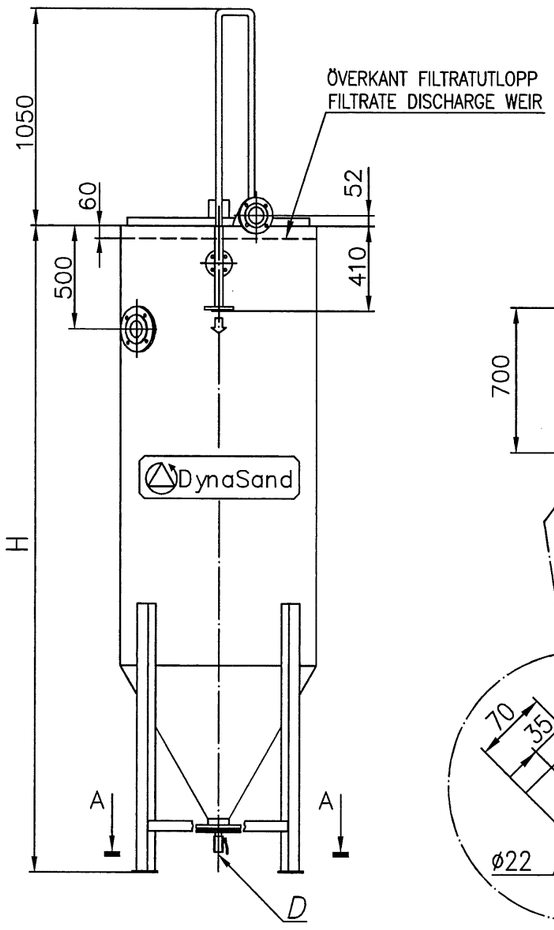
TYPE	SIZE						
SUPERSAND PILOT	36" DIA.						
				1 1/2"=1'-0	1/12	GJJ	JEB	HMH
DATE	STD. BY	STD.CHKD.	STD.APPVD	SCALE	DATE	PROJ. BY	PROJ.CHKD.	PROJ.APPVD

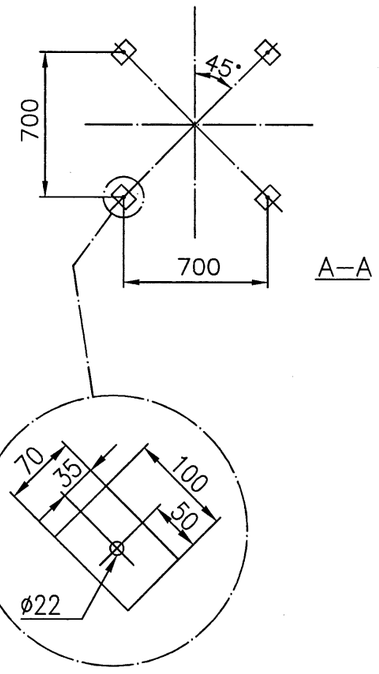
ALL COMPONENTS MUST BE FABRICATED AND MACHINED ACCORDING TO WESTECH STANDARD SPECIFICATION (DRAWING P24Z-024A), UNLESS SPECIFICALLY NOTED ON THIS DRAWING.

WESTECH

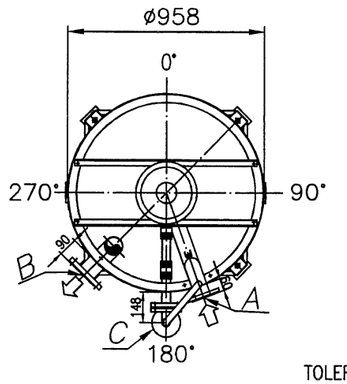
DRAWING NUMBER	PROJECT NUMBER	REV.
D123	R184	A

Rev. No.	Revision / Change	Date	Sign.





1:5



Rätten till ändringar utan avisering förbehålles.
Subject to alteration without prior notice.

Typ Type	H	Sandbäddshöjd Sandbed height	Max. vikt Max. weight	Transport Vikt/Weight	Sandvolym Sand volume
DST 07	mm	m	m ton/metric ton		m 3
AD	4000	2.0	4.6	0.34	2.0
AE	3625	1.5	4.1	0.31	1.5
AN	3125	1.0	3.4	0.28	1.0

Märkn. Mark	Funktion Function	Vinkel Angle	DN	Fläns borrad enligt Flange drilled according to PN	DIN / ANSI
A	Matning Feed	160°	65	10	2642 / 150lb
B	Filtrat Filtrate	225°	80	10	2642 / 150lb
C	Rejekt Reject	180°	40	10	2642 / 150lb
D	Avlopp Drain		Rc 3/4		

TOLERANSER FÖR ICKE TOLERANSSATTA MÅTT ENL. ISO 2768–c
TOLERANCES FOR UNTOLERANCED MEASURES ACC TO ISO 2768–c

Pos Item	Ant Qty	Beskrivning Description	Material Material	Dimension, etc Dimension, etc	Ritn. nr. Drawing No.	Vikt Kg Weight Kg
Datum–Date 930812		Ritad–Drawn RP	Konst.–Designed RP	Kontr.–Checked	Kvalité/Quality STD	Skala–Scale 1:25

NORDIC WATER PRODUCTS AB

DYNASAND
DST07

MÅTTRITNING
DIMENSIONAL DRAWING

Proj.nr–Proj. No.

Blad nr–Sheet No.

Ref. No.

Code: 5

Ritn.nr–Drawing No. 3– 21373

Rev. 6

WESTECH

SuperSand Pilot Rental/Test Agreement

Lessee: **Yelm, WA** Lessor: **WesTech Engineering Inc.**

Proposal no.:**1430391** Date: **11/14/2014**

RCL 11/17/14

The information included in this document ~~and Attachments A and B~~ define the scope of responsibilities to be provided by both the Lessor and Lessee in this Rental/Test Agreement.

1. BASIC PILOT PLANT SPECIFICATIONS:

DESIGN INLET FLOW RANGE:	10 – 20 gpm
POWER SUPPLY REQUIREMENT:	120 V / 60 Hz / 1 ph
WEIGHT:	10,600 lbs. (operating), 900 lbs. (shipping)
PILOT PLANT DIMENSIONS (LxWxH):	3.5' x 3.5' x 13.5'
REQUIRED PILOT WORKING AREA:	5' x 10' minimum

2. EQUIPMENT:

The pilot unit will include the following equipment:

- Filter tank and internals
- Air compressor
- Air control panel
- Filter Media
- Handheld analytical equipment

Filter tank and internal will be on unit and all other components will be mounted on a single skid.

3. TERMS AND CONDITIONS:

3.1 The rental charge will be:

Pilot rental (1st Month):	**$ 7,174**
*Estimated shipping charges: ($2,300 one way Salt Lake City, UT to Yelm, WA)	**$ 4,600**
Refundable cleaning deposit	**$ 500**
Total:	**$ 12,274**

All shipments are F.O.B. Yelm, WA. The shipping cost is estimated. The actual shipping cost may vary depending on costs at the time the pilot unit ships. Shipping charges include estimated shipping cost back to Salt Lake City, UT. Equipment will be shipped by best method possible; flatbed, covered truck, etc. (A forklift of adequate size will be required for removing the equipment from the trailer and placing the pilot unit at the testing location.)

RCL 11/17/14

The pilot plant will ship and arrive at the test site on the agreed upon date, provided the pre-installation task list, ~~see Attachment A,~~ is initialed, signed and received by the lessor prior to the required ship day. Rental shall begin five (5) calendar days after shipment from WesTech. The rental period shall end on the date the return shipment from Lessee. A copy of the shipping manifest is to be sent to WesTech as proof of return ship date.

3.2 Additional monthly rental charges beyond the initial 1st month are prorated on a monthly basis at the rate of $ $2,465 per month.

3.3 Invoices are rendered monthly with lease charges payable in advance. Terms on all invoices will be NET 30 DAYS.

3.4 Title to pilot plant will remain in the name of WesTech Engineering, Inc. unless equipment is purchased and full payment is made for same.

3.5 The Lessee will, at their own expense, carry necessary insurance to protect Lessor and Lessee against all risks to the equipment or any liability arising from the use of said equipment while equipment is in the possession and control of the Lessee. Liability for the Lessee will begin once equipment arrives at the project site and will last for the duration of project until the equipment leaves the project site. Insurance Value of the pilot unit is $ 50,000

3.6 The above rental price is firm for thirty (30) days. All local, state, federal, sales, or manufacturer's taxes of any sort, and such taxes and/or charges pertaining thereto are to be borne by the Lessee.

4. PARTY RESPONSIBILITIES:

4.1 The Lessor will be providing the following equipment, services, and consumables:

Equipment:
- Filter tank and internals
- Air compressor
- Air control panel
- Handheld Analytical Equipment
- Chemical Feed Pump
- WesTech Technician will be onsite for system installation, start-up, operation, testing, and tear down for a period of 6 business days in 2 trips.

Consumables:
- Filter media

4.2 The Lessee will be providing the following equipment, service, and consumables:

Equipment:
- Equipment to unload and place pilot unit at the beginning of the test and equipment needed to load pilot on truck at the conclusion of the test. Pilot dimensions are 13'-2" tall by 3'-2" diameter. Weight is 750 lbs. for filter and 300 lbs for air compressor skid.
- Provide a suitable surface, relatively level, for placement of pilot unit per section one (1) of this agreement. Surface will need to support the operating weight of the pilot unit. Please take care that there are no overhead problems in the proposed placement area.
- Feed pump, inlet, outlet, and waste hoses

Service:
- Manpower for unloading and loading of pilot unit and hooking up and tear down of pilot unit under the supervision of the Lessor's field service representative.
- Repair for avoidable damage.
- Influent Flow
- Handling and disposal of all pilot exit flows including outlet, waste sludge, and excess chemicals.

Consumables:
- 120V 60Hz 1ph power supply.
- Chemical including coagulant and pH adjustment chemicals if necessary.

5. FIELD SERVICE:

The Lessor has included the cost to have one (1) field service technician provide the service described in section 4.1.

The following daily service rates will apply for additional field service (per Field Service Policy). All rates include personnel cost per day plus living and travel expenses:

Process Engineer: $ 960
Technician/Engineer: $ 960
Travel Expenses: Vary by job location
Typical Daily Living Expenses: $200.00 per day*

*Daily Living Expenses include rental car, hotel, and meals. Living expenses can vary by location, actual expenses will be invoiced.

6. TEST PROGRAM AND RESULTS:

Each party's access to the test program results will be discussed and agreed upon prior to the execution of this contract. WesTech Engineering, Inc. will be pleased to maintain data obtained from on site testing. WesTech will also review and evaluate, with the Lessee, the results of the testing data as it relates to the design and specification for full scale equipment.

7. RENTAL RETURN:

The take down and shipping arrangements are the responsibility of the Lessee. Takedown must be performed per WesTech instructions.

The refundable cleaning deposit will be returned to the Lessor provided the equipment is returned properly freighted and packaged to prevent damage, in original condition and cleaned with no abnormal wear, missing or altered parts, and WesTech has received payment for all services. Upon receipt of equipment, WesTech retains the right to bill the Lessee for any major repairs, other than normal wear, and for any cleaning cost over the deposit necessary to return the equipment to the condition in which it was received at the Lesee's plant. To avoid unnecessary cleaning charges, the Lessee should make sure the unit is cleaned and functional before returning.

8. CREDIT ALLOWANCE:

Should the Lessee elect to purchase this equipment, or have WesTech custom build equipment relating to the pilot plant work, a credit of (50%) of the pilot rental cost accrued per section 3.1 of "Terms and Conditions" (not including shipping costs) will be given. Additional field service, testing, chemicals, and all other costs associated with operation of the plant will not be credited. This option is only available if the Lessee elects to purchase or build the unit during the term of this agreement or within six (6) months after termination of rental.

ACCEPTED FOR LESSEE: Yelm, WA

COMPANY: City of Yelm, WA
SIGNATURE: by
PRINT NAME: Ryan Johnstone
DATE: 11/17/14
PURCHASE ORDER NO.: 3361

LESSOR: WesTech Engineering, Inc.

SIGNATURE:
PRINT NAME: MARK FISHER
DATE: 11/20/14

Attachment D

Original Test Plan

Most of the attachments to this document are not included here to avoid repetition. Only the figure attachments for the Original Test Plan are included.

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

1019 39TH AVENUE SE, SUITE 100 | PUYALLUP, WA 98374 | P 253.604.6600

TECHNICAL MEMORANDUM

DATE:	November 24, 2014
TO:	Al Bolinger, Carl Jones, and Greg Zentner Department of Ecology (Ecology)
FROM:	David Kopchynski
SUBJECT:	Test Plan for Pilot Denitrifying Filter Unit
CC:	Ryan Johnstone, City of Yelm; Jim Doty, City of Yelm; John Simon, Goble Sampson; Brian Bunker, Parametrix
PROJECT NUMBER:	216-1781-031 (03/01)
PROJECT NAME:	WRF Support

11-24-14

INTRODUCTION

The City of Yelm (City) and its wastewater consultant, Parametrix, are currently investigating the best short-term possibilities of dosing an external carbon source into the Yelm Water Reclamation Facility (WRF) treatment process train to enhance denitrification. This testing plan provides specific information on equipment and procedures to be employed for tertiary denitrification filter testing with WRF Sequencing Batch Reactor (SBR) effluent that is coagulated with poly-aluminum chloride. A coagulated SBR effluent sample flow will be dosed with an external carbon source (carbon supplementation) and then be fed into a pilot, tertiary, upflow continuous backwashing filter. Simultaneous denitrification and suspended solids removal are expected to occur within the pilot filter.

Currently, the Yelm WRF operates full-scale, upflow continuous backwashing filters in contact filtration mode to only remove total suspended solids (TSS) and turbidity from the SBR effluent. Contact filtration is defined as coagulant addition with mixing only. The pilot test filter is highly similar in configuration to the existing WRF full-scale filters (e.g., pilot unit is also an upflow continuous backwashing filter and shares the same sand media depth [2 m] as the WRF full-scale filters). The tertiary denitrification filter process has been successfully implemented in municipal wastewater treatment plants and is described in an EPA Wastewater Management Fact Sheet which is provided in Attachment A for reference.

The purpose of the pilot testing is to determine the following:

1. Can filter denitrification conditions occur at lower effluent water temperatures (6 to 10 degrees Celsius)?

2. Confirm that a synthetic, external carbon source, such as, can be successfully employed to create denitrification conditions in the pilot test filter. MicroC 2000™ has lower flammability and safety requirements than methanol and more detailed information on this product is provided in Attachment B. Unless deemed necessary, methanol feed to the pilot filter will not be attempted for this pilot study.

3. How will carbon supplementation at the tertiary filters impact coagulant (poly-aluminum chloride)dosage and filtration rates to achieve effective turbidity and solids removal to meet reclaimed water permit requirements (2 NTU, average monthly turbidity limit and 5 NTU, sample maximum turbidity limit with 30 mg/L average monthly total suspended solids limit)?

4. What levels of dissolved oxygen are required in the filter influent to allow for effective denitrification and will existing hydraulic structures downstream of the full-scale filters be sufficient to re-aerate filter effluent?

EQUIPMENT, SERVICES, AND MATERIALS TO BE EMPLOYED

The existing treatment plant equipment that will be used for pilot testing includes:

1. Coagulated SBR effluent sample 1-inch-diameter PVC suction and return piping used to provide flow to WRF on-line turbidity and pH meters. These meters provide no control function to the WRF at this time they are provided for monitoring purpose only.

2. pH and turbidity.

3. Coagulated SBR effluent pH and turbidity meters will continue to operate for both pilot testing and full-scale filter operation.

4. The existing coagulated SBR effluent sample pump (currently 1/2 HP) will be replaced with a slightly larger pump of similar style (3/4 to 1 HP) to allow for proper feed flow to the pilot test unit.

5. Process drain piping to convey pilot filter treated and backwash flows back to the head of the WRF.

6. Spare composite auto sampler unit to sample pilot filter effluent.

Pilot equipment, services, and materials that will be provided by the filter manufacturer includes:

1. Portable filter unit.

2. Portable compressed air system.

3. Sand for the filter unit.

4. Handheld instrumentation to measure nitrate, turbidity grab/composite samples when manufacturer staff are on-site.

5. The rental agreement and further details of the pilot filter test equipment are provided in Attachment C.

Equipment, services, or materials that will be provided by the City for the pilot testing includes:

1. 55-gallon drums or single 270-gallon tote of MicroC 2000™. Expected doses and daily usage rates are computed in a following section of this test plan.

2. On-site laboratory staff services labor and equipment to conduct turbidity, dissolved oxygen, total nitrogen, ammonia, nitrate, nitrite and biochemical oxygen demand (BOD) analyses.

3. Upgraded raw filter influent sample pump that will deliver sufficient flow to the pilot test unit.

4. Hoses and flow controls to direct flow from the raw filter influent sample pump into the filter. The City will also provide overflow piping from the pilot test unit down to the area drains. Autosampler for drawing pilot filter effluent samples and labor to set up autosampler.

5. Lifting equipment (fork lift or crane) and labor to unload and reload pilot filter equipment.

PILOT TEST SETUP PROCEDURE

The pilot plant facilities will be set up in the following order:

1. Pilot Test Unit Setup

The pilot testing unit will be set up in the covered sludge truck loading bay adjacent to the belt filter press room. The filter will be set in such a way to allow continued and uninterrupted loading of thickened waste activated sludge within the designated loading area.

The City will provide a crane or forklift and required labor to unload, set up, shut down and reload the filter unit for shipping back to manufacturer. A manufacturer's technician will be present to assist in the setup of the pilot filter unit.

The pilot filter unit will be secured with anchor bolts that are provided by the manufacturer.

Pilot test filter drain piping and backwash waste piping will be directed down to the existing drain located on the sludge loading area pad. Flow from this 3-inch drain and associated piping is directed to the plant drain.

2. Pilot Test Unit Feed Pumping and Piping Systems Setup

Since the WRF coagulated SBR effluent sample pump is only required for internal plant monitoring purposes, its operation can be temporarily shut down for a day period to allow the following pump and piping modifications to be implemented:

- City to procure larger sample pump, piping, and sample flow metering devices (Maric style flow control valves and flow rotameter, connecting piping, and hoses to the pilot filter).
- Setup of new larger sample pump (wiring and piping connections).
- Connection of new sample pump suction port to existing sample draw point for WRF coagulated SBR effluent.
- Connection of new sample pump discharge to the inlet of the pilot test filter.

3. Sampling and Testing Equipment Setup

An existing spare autosampler will be set up by the City to collect daily pilot filter effluent composite samples. Also, grab samples will be taken and analyzed as directed in the Testing Plan Procedures below.

General locations of pilot testing equipment are shown in Figure 1. A basic summary of how piping and pilot test components will be tied into existing WRF facilities is provided in Figure 2.

TESTING PLAN PROCEDURES

The pilot test is proposed to be one to two months in duration. The primary purpose of the pilot test is to confirm the following operational criteria before full-scale implementation can be considered:

- How will cold temperature conditions impact filter denitrification rates, and what denitrification rates will be achievable at filter loading rates of 2 and 3 gpm/ft^2 of filter using a range of MicroC dose rates?
- How will filter denitrification impact the contact filtration process and what impacts on effluent turbidity and coagulant dosage will occur?
- How will dissolved oxygen in the pilot filter influent impact the filter denitrification rates? During pilot testing, the SBR effluent equalization storage pond mixer will need to be shut off for periods of time in order to better control the amount of dissolved oxygen in the coagulated SBR effluent flow being delivered to the pilot filter.

Pilot System Operation Plan

To provide information for the above operational criteria, the following test schedule and protocol matrix has been developed:

Test Time Period	Testing Activity
Day 1 through Day 7 – Setup and Startup	Operate filters at 1 gpm/ft^2 loading rate. Initially the filter will be operated with a minimal bed turnover time to allow development of biology within the filter sand media. Start MicroC dosage at manufacturer recommended level for seeding and startup. Pilot filter may be seeded with WRF mixed liquor to more quickly activate filter biology. Adjust WRF full-scale SBR effluent equalization (EQ) storage pond mixer operation to provide less than 1 mg/L of dissolved oxygen in the pond. Check reclaimed water pump station wet dissolved oxygen levels throughout pilot testing to verify re-aeration occurs at full scale across the WRF filter effluent weirs and across WRF chlorine contact basin weirs.
Day 7 through Day 21 – Operation Mode 1	Operate filters at 2 gpm/ft^2 loading rate, provide initial 30 mg/L as chemical oxygen demand (COD) MicroC dosage rate*, and step up Micro C dosage to achieve at least 3 to 5 mg/L of nitrate across filter during mode test period.
Day 21 through Day 35 – Operation Mode 2	Operate filters at 3 gpm/ft^2 loading rate, provide initial 30 mg/L as COD MicroC dosage rate[a], and step up dosage to achieve at least 3 to 5 mg/L of nitrate across filter during mode test period.
Day 21 through Day 60 – Operation Mode 3	Operate filters at optimal loading rate determined from Modes 1 and 2 test periods but attempt to increase MicroC dosage under this mode of operation to achieve higher removal rates of nitrate (5 to 7 mg/L) across the pilot test filter.

a A filter running at 2 gpm/ft^2 will be receiving approximately 14 gpm of flow and 21 gpm of flow at a 3 gpm/ft^2 loading rate. MicroC 2000™ will have a COD of approximately 1,000,000 mg/L (See Attachment B for product information on MicroC 2000™.) So a 30 mg/L MicroC dosage at pilot filter influent flow of 14 gpm would require about a 0.60 gallon per day feed rate of MicroC. Theoretically, 3 to 4 pounds of MicroC COD is expected to be required to remove 1 pound of nitrate. Pilot testing will help to determine actual site specific COD dose requirements.

Sampling and Analysis Plan during Pilot Test

The following monitoring plan will be used for the pilot testing period:

Frequency of and Type of Sampling/Readings During Pilot Filter Operation	Analyses to be Conducted on Sample
Up to Three Times a Week – Effluent Daily Composite Sample	• Effluent DO, nitrite, Total Kjeldahl Nitrogen (TKN), ammonia, nitrate, COD, BOD, and turbidity analyzed at WRF laboratory.
Up to Three Times a Week – Grab Sample	• Pilot filter influent dissolved oxygen, temperature, pH, flow, COD, ammonia, nitrate, nitrite, TKN and oxidation reduction potential (ORP). • Pilot filter effluent dissolved oxygen, temperature, pH, and ORP. • All tests conducted using hand held meters, local WRF instrumentation, or WRF lab equipment provided at the pilot test location. Testing data may also be pulled from process monitoring tests already being performed on WRF filter influent. • Note all times when grabs are taken and processed.
Recording of Values or Field Measurements for Each Week Day	• Volume of MicroC used up since last reading taken. • Current coagulant dosage applied at full-scale filters. • Head loss across filter. • Backwash waste flow rate. • Influent flow rate to pilot filter. • In field dissolved oxygen measurements at the WRF SBR effluent equalization storage pond and at the reclaimed water pump station wet well. • Note time when readings are taken.
Once a Week – Effluent Daily Composite Sample Quality Control Check	Effluent TKN, nitrate, nitrite, ammonia, turbidity, and COD to be analyzed by an outside laboratory.

Analysis of samples will only be conducted up to three times a week on weekdays. During weekends, no samples will be obtained or analyzed. WRF plant staff will conduct all sample analyses except for on the weekly composite quality control sample which will be sent to an outside laboratory for analysis. The following equipment or testing methods will be used to analyze samples:

- pH – WRF laboratory bench top meter.
- Turbidity – WRF laboratory bench top meter, Quality Assurance/Quality Control (QA/QC) samples to be analyzed by outside laboratory accredited by Ecology.
- ORP – WRF handheld meter.
- pH – WRF lab bench top meter.
- Dissolved Oxygen and Temperature – WRF handheld meter.
- BOD – Using WRF laboratory equipment and Standard Method 5210B, WRF laboratory is accredited by Ecology to conduct BOD tests.
- COD – Using WRF laboratory equipment and Standard Method 5220D; QA/QC samples to be analyzed by outside laboratory accredited by Ecology.
- Ammonia, Nitrite, Nitrate and TKN – WRF laboratory bench top ion selective nitrate electrode or spectrophotometer; WRF is certified by Ecology to performance ammonia analysis for compliance testing. QA/QC samples to be analyzed by outside laboratory accredited by Ecology.

Figures

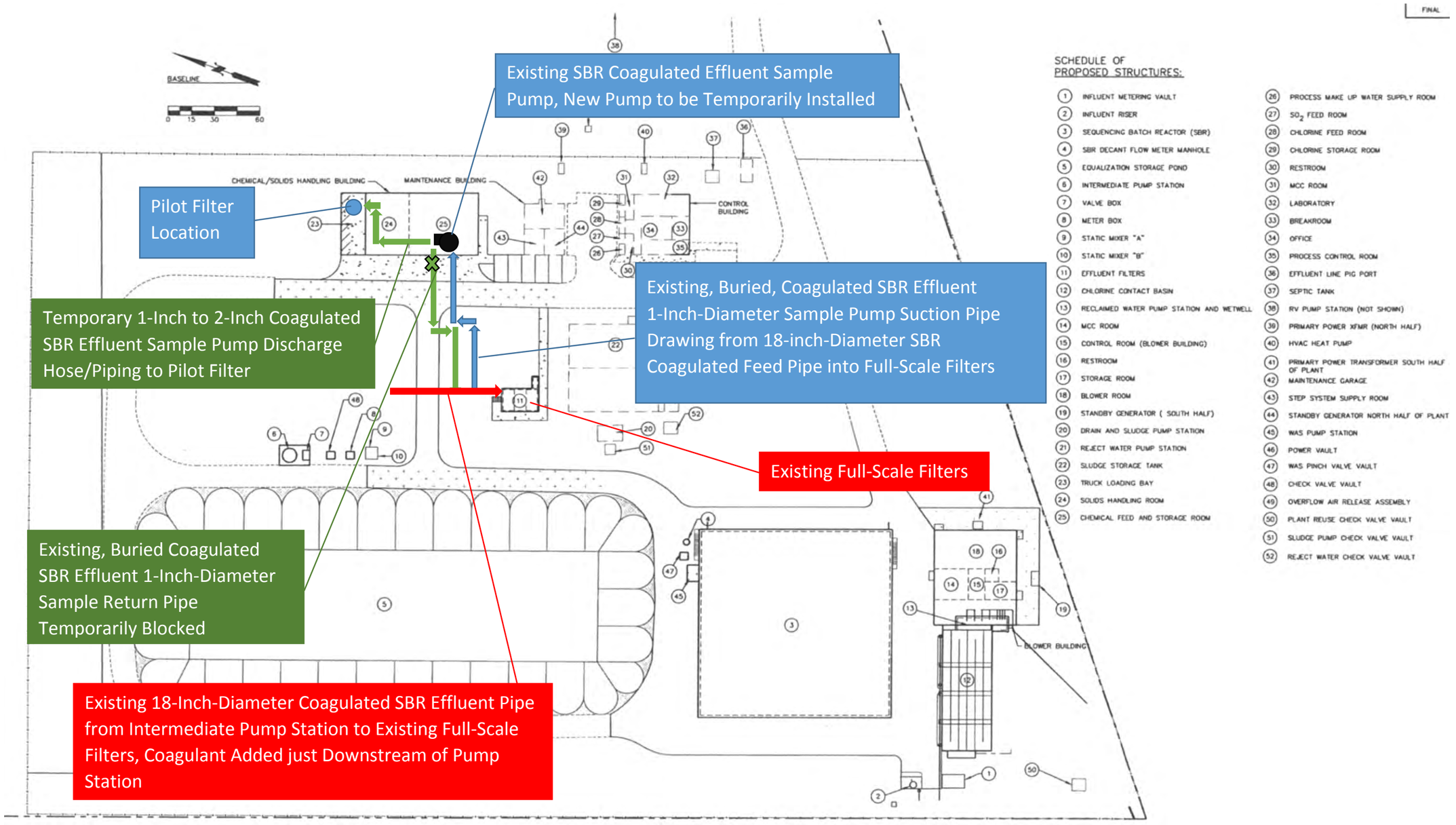


Figure 1 – WRF Site Plan
(Note: Modified From Sheet Z-1 – Process Zones,
Skillings and Connolly 1999 City of Yelm Water Reuse Project Record Drawings)

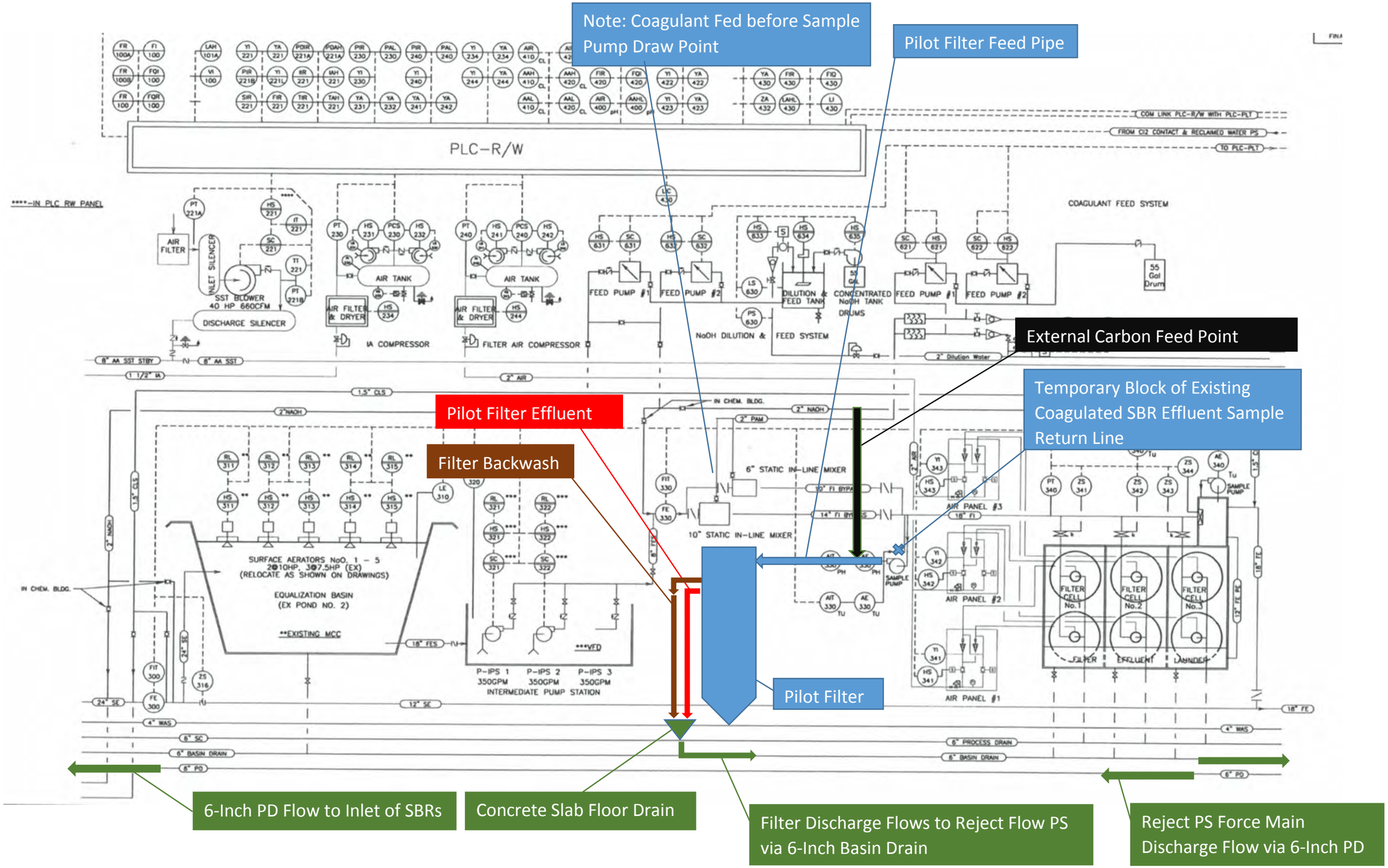


Figure 2 – Process Flow Diagram
(Note: Modified From Sheet PID-2 – Process and Instrumentation Diagram, Skillings and Connolly 1999 City of Yelm Water Reuse Project Record Drawings)

Attachment E

EPA Wastewater Management Fact Sheet

Wastewater Management Fact Sheet

Denitrifying Filters

United States Environmental Protection Agency

INTRODUCTION

Discharge permits for treated wastewater from publicly owned treatment works (POTWs) often include effluent limitations for nutrients. Total maximum daily loads (TMDLs) for nutrients are being developed for many waterbodies throughout the United States. TMDLs and other water quality-drivers have resulted in POTWs having to comply with more stringent effluent limitations for parameters such as total nitrogen (TN).

Untreated domestic wastewater contains ammonia. Nitrification is a biological process that converts ammonia to nitrite and nitrite to nitrate. If standards require that the resulting nitrate be removed, one treatment alternative is the process of denitrification, in which nitrate is reduced to nitrogen gas. One treatment system used for denitrifying wastewater effluent is the denitrifying filter. In addition to the reduction of total nitrogen, this treatment process removes suspended solids from the effluent.

NITRIFICATION/DENITRIFICATION

Nitrification is a microbial process by which ammonia is sequentially oxidized to nitrite and then to nitrate. The nitrification process is accomplished primarily by two groups of autotrophic nitrifying bacteria that can build organic molecules by using energy obtained from inorganic sources—in this case, ammonia or nitrite.

In the first step of nitrification, ammonia-oxidizing bacteria oxidize ammonia to nitrite according to equation (1):

$$NH_3 + O_2 \rightarrow NO_2^- + 3H^+ + 2e^- \quad (1)$$

Nitrosomonas is the most frequently identified genus associated with this step, although other genera, including *Nitrosococcus* and *Nitrosospira*, may be involved. The subgenera *Nitrosolobus* and *Nitrosovibrio* can also autotrophically oxidize ammonia.

In the second step of the process, nitrite-oxidizing bacteria oxidize nitrite to nitrate according to equation (2):

$$NO_2^- + H2O \rightarrow NO3^- + 2H^+ + 2e^- \quad (2)$$

Nitrobacter is the genus most frequently associated with this second step, although other genera, such as *Nitrospina*, *Nitrococcus*, and *Nitrospira*, can also autotrophically oxidize nitrite (U.S. EPA, *Nitrification,* August 2002).

Denitrification is the process by which nitrates are reduced to gaseous nitrogen by facultative anaerobes. Facultative anaerobes, such as fungi, can flourish in anoxic conditions because they break down oxygen containing compounds (e.g., NO_3^-) to obtain oxygen. Once introduced into the aquatic environment, nitrogen can exist in several forms—dissolved nitrogen gas (N_2), ammonia (NH_4^+ and NH_3), nitrite (NO_2^-), nitrate (NO_3^-), and organic nitrogen as proteinaceous matter or in dissolved or particulate phases. The energy reactions are (Metcalf and Eddy, 1979):

$6\ NO_3^- + 2\ CH_3OH \rightarrow 6\ NO_2^- + 2\ CO_2 + 4\ H_2O$ (Step 1)

$6\ NO_2^- + 3\ CH_3OH \rightarrow 3\ N_2 + 3\ CO_2 + 3\ H_2O + 6\ OH^-$ (Step 2)

Overall,

$6\ NO_3^- + 5\ CH_3OH \rightarrow 5\ CO_2 + 3\ N_2 + 7\ H_2O + 6\ OH^-$

The organisms carrying out this process are called *denitrifiers*. In general, they are heterotrophic bacteria that metabolize readily biodegradable substrate under anoxic conditions using nitrate as the electron acceptor. If oxygen is available, these bacteria use it for metabolism before they use the nitrate. Therefore, dissolved oxygen concentrations must be minimized for the denitrification process to function

efficiently. Oxygen is typically minimized by avoiding aeration of the wastewater and having a high concentration of biochemical oxygen demand (BOD) so that the microorganisms use all the oxygen.

A readily biodegradable organic compound (a carbon source) must be available for the denitrifiers to use. Because the typical denitrifying filter installation is downstream of aerobic treatment, in which most of the organic material is oxidized, some organic material must be added to the filter influent to sustain the growth of the denitrifiers. The carbon source most often selected is methanol, which is readily degraded under anoxic and aerobic conditions. Other carbon sources, such as acetic acid, also can be used in denitrifying filter systems.

DESIGN FEATURES

Filter Configurations

Denitrifying filters have been utilized for wastewater treatment for a number of years. The combination of denitrification and solids removal was first patented in the 1970s. Since that time, several companies have developed their own denitrifying filters. In addition to meeting TMDL requirements, facilities such as the East Central Regional Water Reclamation Facility in West Palm Beach, Florida, are utilizing denitrification filters as part of an advanced wastewater treatment system to enable them to reuse treated wastewater to augment wetlands and to recharge aquifers (Figures 1 and 2).

There are two main process configurations for denitrification filters commercially available, downflow and upflow continuous backwash filters.

Downflow denitrification filters operate in a conventional filtration mode and consist of media and support gravel supported by an underdrain. Manufacturers include Severn Trent Services (Fort Washington, Pa.), maker of the TETRA Denite system; F.B. Leopold Co. Inc. (Zelienople, Pa.), maker of the elimi-NITE system; and Siemens Water Technology Davco

Figures 1 and 2. Denitrifying filters at the East Central Regional Water Reclamation Facility, West Palm Beach, Florida

Products (Thomasville, Ga.), maker of the Davco denitrification filter.

Wastewater enters a downflow filter over weirs along the length of the filter bed on both sides. Filter effluent is conveyed from the bottom of the filter over a control weir into a clear well. Backwashing is required at regular intervals. Backwashing typically involves air scouring and backwashing with air and water. During the process, nitrate is metabolized to nitrogen gas, which becomes embedded in the filter media. Nitrogen-release cycles are needed to remove these nitrogen gas bubbles that accumulate. The piping for the filter influent and backwash is similar to that of conventional filters.

Upflow continuous-backwash filters differ in that influent wastewater flows upward through the filter, countercurrent to the movement of the sand bed.

Wastewater enters the filter through the influent pipe (where methanol can be added), and then is transported downward through a supply pipe and distributors (Figure 3). The water moves up through the filter media and filtrate is discharged from the upper portion of the filter. The filter media travels slowly downward and is drawn into an airlift pipe in the center of the filter. Compressed air is introduced to the airlift, drawing sand upward and scouring it. At the top of the airlift, the media is returned to the filter bed. Filtered water rises through a separator that removes the light dirt particles by washing them away and returns the large, heavy sand grains to

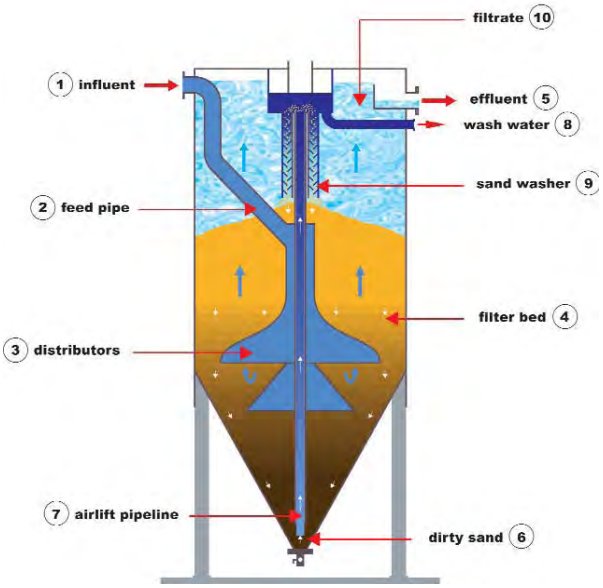


Figure 3. Astrasand upflow continuous-backwash filter.

the top of the filter bed. The reject, or backwash, water continuously exits near the top of the filter. The reject-water weir is set at a lower elevation than the effluent weir to allow clean water to enter the washer and separator continuously by differential head, eliminating the need for typical backwash-supply pumps.

Manufacturers include Parkson Corp. (Fort Lauderdale, Fla.), maker of the DynaSand filter, and Paques bv (Balk, Netherlands), maker of the Astrasand filter. Siemens Water Technologies has a license agreement with Paques to supply this filter in the United States and Canada.

Filter Design Characteristics

When designing a denitrification filter, there are many considerations that should be taken into account by wastewater professionals. Table 1 presents a brief overview of the systems offered by different manufacturers (deBarbadillo et al. 2005). Major design considerations include 1) a manufacturer's experience and 2) the system's performance, which includes influent weir configuration, types of filter media, underdrain, process controls such as backwash and filter control, and methanol feed control.

Filter Influent Weirs

Many downflow denitrification filters are capable of being operated at variable levels and may have a significant drop over the influent weir. This drop can result in the entrainment of dissolved oxygen (DO). The increase in DO reduces the efficiency with which the filter removes nitrate and increases methanol consumption. In order to address this issue, manufacturers have developed different designs to mitigate the problem. The TETRA Denite system has a patented curvilinear weir block to encourage laminar flow down the wall to minimize DO entrainment. The elimi-NITE system can also be installed with a curved stainless steel weir to solve this problem. Additionally, the F.B. Leopold Company has suggested that operating the system in a constant-level mode would reduce the elevation drop from the influent weir, thereby decreasing the level of DO entrainment. Since influent in upflow continuous-backwash filters is conveyed to the feed radials within the filter bed through submerged manifold piping, DO entrainment over the influent weir is less an issue for those filters utilizing this configuration.

Media

The preferred media for each filter manufacturer is also presented in Table 1. The filter media in the TETRA Denite system consists of a monomedia granular sand with a two to three millimeter effective size. Uniform and relatively spherical media reportedly allow for more rolling and contact with other media grains, resulting in more effective backwash and nitrogen-release cycles and, ultimately, lower backwash water volume requirements. Davco filters can be supplied with the same media. Finer media are used with the DynaSand and Astrasand filters that utilize the upflow continuous-backwash filter design.

Underdrain

Early experience with downflow denitrification filters suggested that nozzle underdrains were prone to fouling and failure. To avoid these problems, manufacturers have developed unique block underdrains (Figure 4) (deBarbadillo et al. 2005). Severn Trent Services offers the TETRA T-block underdrain, which is specifically designed for bioreactor service and consists of concrete-filled blocks enclosed in high-density

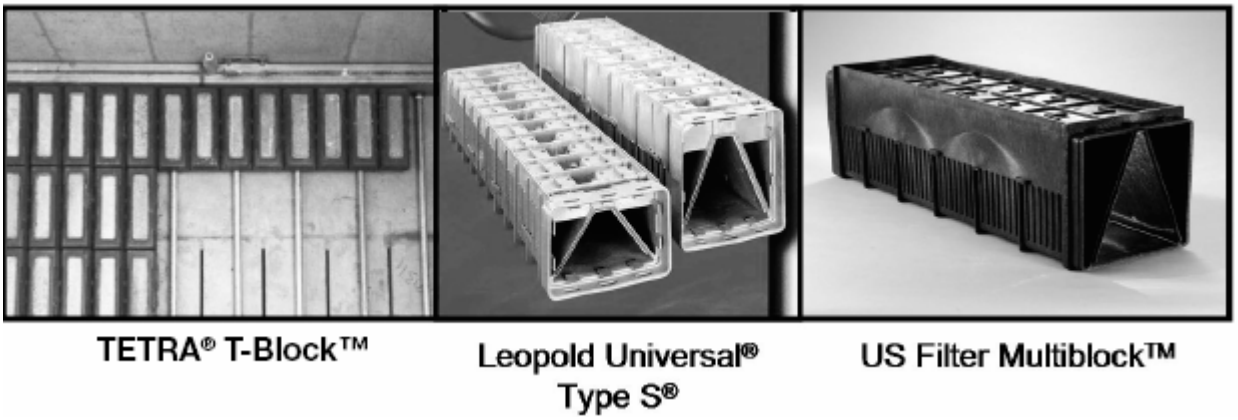


Figure 4. Block Underdrain Systems.

polyethylene (HDPE). F.B. Leopold developed its Universal Type S underdrain, which consists of HDPE blocks. Although existing Davco filters were constructed with pipe lateral underdrains, new installations will be supplied with the Multiblock HDPE underdrain. Upflow continuous-backwash filters do not require an underdrain.

Nitrogen Release Cycle

During the denitrification reaction, nitrogen gas accumulates in the media bed. Wastewater is forced to flow around the gas and increases head loss in the filter. The nitrogen release cycle emits the nitrogen gas into the atmosphere. The TETRA Denite system offers a control package, known as SpeedBump, which pumps backwash water up through the filter for 30 seconds to 2 minutes. The influent valve to the filter remains open to minimize filter downtime. The elimi-NITE and Davco systems offer nitrogen-release cycles that fully close the influent valve, and the additional time required for the nitrogen-release cycle should be accounted for in the filter design. Since the DynaSand and Astrasand upflow systems operate in the same direction that the nitrogen gas travels, and the gas also is drawn into the airlift, a separate degassing cycle is unnecessary.

Backwashing and Filter Controls

During operation of the denitrification filter, solids removed from the wastewater accumulate in the media. Additional solids from the growth of denitrifying bacteria also build up in the filter media. This increases the head loss in the filters. To clean the media, backwashing cycles for the downflow filters are initiated on the basis of increased head loss through the filter or on a timed basis. All three manufacturers of downflow filters offer air scouring and air-water backwash as part of the backwash cycle. Integrated process control systems are offered for the TETRA Denite, elimi-NITE, and Davco filtration systems which control the backwashing, air-scour, and nitrogen-release cycles.

The DynaSand and Astrasand systems operate with a small continuous-backwash stream. A process monitoring tool for the Astrasand filter, the Astrameter system, is used to measure the sand circulation rates at several locations throughout the filter.

Questions remain regarding the bed turnover rate (backwash frequency) and how it relates to maintaining good solids removal while supporting sufficient biomass for denitrification. Available for use with the Astrasand filter, the Astracontrol system was developed to maintain biological activity within the filter under varying conditions.

The control system continuously adjusts the media movement and washing rate to maintain a fixed volume of active biomass in the filter. Studies performed by Siemens Water Systems suggest that optimizing the backwash rate based on hydraulic loads through automation of the airlift provides excellent control of the process (Freed and Pauwels). Parkson Corporation has indicated that changing the bed turnover rate in the DynaSand system might be necessary to

Table 1. Comparison of Denitrification Filter Manufacturers and Equipment

Manufacturer/ filter	Severn Trent Services/ TETRA® Denite®	F. B. Leopold/ elimi-NITE	USFilter/Davco	Parkson/ DynaSand	Paques and USFilter/ Astrasand
Flow regime	Downflow	Downflow	Downflow	Upflow	Upflow
Underdrain	T-block; concrete-filled, HDPE jacket	Universal Type S HDPE block	Pipe lateral; or Multiblock HDPE block	None required	None required
Air header arrangement	SS box header; laterals beneath underdrain	SS header across filter; laterals	SS air header; 50-mm (2-in.) laterals	Vertical air lift	Vertical air lift
Media	457 mm (18 in.) graded gravel, 1.8 m (6 ft) of 6 × 9 mesh silica sand, uniformity coefficient 1.35, 0.8 minimum sphericity	381 mm (15 in.) graded gravel, 1.8 m (6 ft) of 6 × 12 mesh sand	2 layers support gravel, 1.8 m (6 ft) of 6 × 9 mesh sand	1.35 to 1.45 mm subround media or 1.55 to 1.65 mm subangular media with uniformity coefficient of 1.3 to 1.6; 2-m (6.6-ft) bed depth	1.2 to 1.4 mm sand, 2-m (6.6-ft) bed depth
Nitrogen-release cycle	Initiated by headloss or time-controlled cycle; Speed Bump controls	Initiated by headloss or time-controlled cycle	Initiated by headloss or time-controlled cycle	None required	None required
Backwash water and air requirement	244 L/min·m² (6 gal/min·ft²); 1.5 m³/min·m² (5 scfm/ft²)	244 L/min·m² (6 gal/min·ft²); 1.5 m³/min·m² (5 scfm/ft²)	407 L/min·m² (10 gal/min·ft²); 1.5 m³/min·m² (5 scfm/ft²)	Continuous through air lift and sand washer	Continuous through air lift and sand washer
Influent weir type	Curvilinear weir block	Curved stainless steel weir	Varies	Feed radials at bottom of unit	Feed radials at bottom of unit
Backwash flow as percent of forward flow	<5; often 1 to 2	2	Not documented	3 to 5	3 to 12
Patented features	T block underdrain, curvilinear weir block, Speed Bump, TetraPace, TetraFlex	Universal underdrain and features	None	None	None in United States; Astracontrol in Europe

HDPE = high-density polyethylene.

SS = Stainless steel

meet a specific requirement. However, the company has not seen a need to adjust it during routine operation

Table 1 Courtesy of Christine deBarbadillo

Methanol Feed Control System

Methanol is usually dosed to the filter influent before it is divided among the filter cells. In the Denite system, methanol is dispensed on the

basis of the filter influent flow rate and the concentrations of nitrate in the influent and

effluent, as measured by an online nutrient analyzer. The manufacturer guarantees no net increase in total organic carbon across the filter when this control system is used.

The other manufacturers suggest using the filter influent flow rate and nitrate concentration to determine the methanol dosage through a flow-paced or feed-forward automatic control system. Although a feed-forward control scheme can reasonably match methanol dosing to actual requirements, periods of slight overdosing and the resulting increase in concentrations of biochemical oxygen demand (BOD) in the filter effluent might be difficult to avoid. In cases in which effluent BOD and nitrate-nitrogen limits are less stringent, the need for a high level of methanol control is related to optimizing chemical usage.

Costs

There are several factors that are related to a denitrification filter system's capital costs. Depending on the application and overall effluent requirements, it might be desirable at times to use a more conservative design for filters in meeting the required limit. Alternately, pilot testing can be conducted to verify the design loadings. Another factor that may affect the overall cost of the project includes whether the influent and backwash piping and the valves associated with downflow filters are installed outdoors or housed in a building.

In addition to capital cost, operational costs are also important. The energy costs associated with backwashing, air-scour, and nitrogen-release cycles must be considered, along with a proper accounting of the frequency of these operations. The cost of "retreatment" of spent backwash water must also be included: Filters using only 2 percent of the forward flow for backwashing have a lower cost for treatment than those that consume greater amounts of backwash water. Finally, the ability to optimize methanol dosages can affect the operating cost significantly. Some facilities have reduced their chemical consumption as much as 30 percent after implementing more efficient control systems.

Costs will differ for new plants and retrofits. Retrofit costs are more site-specific and vary considerably for any given size category. Retrofit costs are based on the same factors as new plants, in addition to the layout and design of the existing treatment processes. A case study performed for the Maryland Department of the Environment suggests costs in dollars per pound of total nitrogen removed can range from $0.55 to $7.69. For these examples, this equates to a cost of approximately $1.46 per gallon of wastewater treated (Maryland Department of the Environment, 2005).

ACKNOWLEDGMENTS

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United States
Environmental Protection
Agency

EPA 832-F-07-014
Office of Water
September 2007

Appendix G

Cost Analysis of Liquid and Solids Stream Treatment Alternatives

City of Yelm
Planning-Level Cost Opinion Worksheet - Liquid Stream Alternatives
WRF Sewer Facilities Plan

Alternative 1 Convert to Liquid Disinfection and Dechlorination, Upgrade and Expand Existing Filters, Add Influent EQ
Prepared by: D. Kopchynski

Item Number	Description	Quantity	Unit	Unit Price	Total
1	Existing Tertiary Filter Internals Replacement with Backwash Upgrade	1	LS	$ 362,000.00	$362,000
2	Tertiary Filter Expansion with Backwash Upgrade	1	LS	$ 450,000.00	$450,000
3	Existing SBR Misc Repairs - Coatings/Piping	3	LS	$ 75,000.00	$225,000
4	Influent Equalization Basin, EQ Pump Station, SBR Drain Pump Station	1	LS	$ 750,000.00	$750,000
5	SBR Process Blower Replacement	1	LS	$ 350,000.00	$350,000
6	SBR Basin Diffuser Air Replacement	1	LS	$ 700,000.00	$700,000
7	RV Dump Station Improvements	1	LS	$ 200,000.00	$200,000
8	Chlorine Disinfection System Upgrades - Liquid Hypochlorination System	1	LS	$ 250,000.00	$250,000
9	Dechlor System Upgrades	1	LS	$ 50,000.00	$50,000
10	Reject Water Pump Station Replacement	1	LS	$ 150,000.00	$150,000
11	Intermediate Pump Station Minor Upgrades	1	LS	$ 100,000.00	$100,000
12	Drain and Sludge Pump Station Replacement	1	LS	$ 250,000.00	$250,000
13	Reclaimed Water Pump Station Improvements	1	LS	$ 350,000.00	$350,000
14	Influent Chemical Feed Building	1	LS	$ 250,000.00	$250,000
15	Plant Electrical Improvements	1	LS	$ 1,800,000.00	$1,800,000
16	Plant SCADA, Controls, and Instrumentation	1	LS	$ 1,100,000.00	$1,100,000
17	Plant Control Building Expansion	1	LS	$ 150,000.00	$150,000
18	Other	1	LS	$ -	$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35	Contractor Installation at 10% of Equipment/Materials Cost	1	LS	$748,700	$748,700
36	Mobilization at 5% of Equipment/Materials Costs	1	LS	374,350	$374,350
37	Contractor Overhead and Profit at 10%	1	LS	$748,700	$748,700
38					$0
39					$0
				Subtotal	**$ 9,358,750**
			Contingency	30%	
			Sales Tax	8.7%	
			Planning Level Construction Cost		**$ 12,980,586**
			Administration, Legal	10%	$ 1,298,059
			Engineering/Permitting/Construction Management	20%	$ 2,596,117
				PROJECT TOTAL:	**$ 16,874,762**

ASSUMPTIONS:
Total project budget includes contingencies, sales tax, engineering, permitting, admin, and construction.

City of Yelm
Planning-Level Operations and Maintenance Cost Opinion Worksheet
WRF Liquid Stream Alternative 1 - Sewer Facilities Plan

Project: Current WRF Liquid Stream O&M Costs
By: D. Kopchynski

					Escalation Rates								
					Repair/Equip	**1.02**	**Labor**	**1.02**	**Chemical**	**1.01**	**Power**	**1.02**	
						Annual Costs						**5%**	
End of Year	**Avg. Daily Flow (gpd)**	**Liquid Hypo Chlorine**	**MagOH**	**Suppl. Carbon**	**Liquid Bisulfite Dechlor**	**ACH**	**Labor**	**Electrical**	**Small Repair**	**Utilities****	**Major Replace**	**Contingency***	**Annual Total**
0													
1	400,000	$39,200	$62,800	$38,000	$17,600	$27,800	$332,800	$84,400	$17,600	$4,400		$14,600	$639,200
2	440,000	$43,500	$69,800	$42,200	$19,500	$30,900	$339,520	$94,700	$19,700	$5,000		$16,300	$681,200
3	480,000	$47,900	$76,900	$46,500	$21,500	$34,000	$346,320	$105,400	$21,900	$5,500		$18,000	$724,000
4	520,000	$52,500	$84,100	$50,900	$23,500	$37,200	$353,200	$116,500	$24,200	$6,100		$19,800	$768,000
5	550,000	$56,000	$89,900	$54,400	$25,100	$39,700	$360,240	$125,600	$26,100	$6,600		$21,200	$804,900
6	600,000	$61,700	$99,000	$59,900	$27,700	$43,800	$367,440	$139,800	$29,100	$7,300		$23,500	$859,300
7	640,000	$66,500	$106,700	$64,500	$29,800	$47,200	$374,800	$152,100	$31,600	$7,900		$25,400	$906,500
8	680,000	$71,400	$114,500	$69,200	$32,000	$50,600	$382,320	$164,800	$34,300	$8,600	$5,858	$27,600	$961,200
9	720,000	$76,300	$122,400	$74,000	$34,200	$54,100	$390,000	$178,000	$37,000	$9,300		$29,300	$1,004,600
10	760,000	$81,400	$130,500	$78,900	$36,500	$57,700	$397,760	$191,700	$39,800	$10,000		$31,400	$1,055,700
11	800,000	$86,500	$138,700	$83,900	$38,800	$61,300	$405,760	$205,800	$42,800	$10,700		$33,500	$1,107,800
12	850,000	$92,800	$148,900	$90,000	$41,600	$65,800	$413,840	$223,000	$46,300	$11,600		$36,000	$1,169,900
13	880,000	$97,000	$155,700	$94,200	$43,500	$68,800	$422,080	$235,500	$48,900	$12,300		$37,800	$1,215,800
14	920,000	$102,500	$164,400	$99,400	$45,900	$72,700	$430,560	$251,100	$52,200	$13,100		$40,100	$1,272,000
15	960,000	$108,000	$173,200	$104,800	$48,400	$76,600	$439,200	$267,300	$55,500	$13,900		$42,400	$1,329,300
16	1,000,000	$113,600	$182,300	$110,200	$50,900	$80,600	$447,920	$284,000	$59,000	$14,800	$6,864	$45,200	$1,395,400
17	1,040,000	$119,300	$191,400	$115,800	$53,500	$84,600	$456,880	$301,300	$62,600	$15,700		$47,300	$1,448,400
18	1,080,000	$125,200	$200,800	$121,400	$56,100	$88,800	$466,080	$319,100	$66,300	$16,600		$49,800	$1,510,200
19	1,120,000	$131,100	$210,300	$127,200	$58,700	$93,000	$475,360	$337,500	$70,100	$17,600		$52,300	$1,573,200
20	1,160,000	$137,100	$220,000	$133,000	$61,400	$97,200	$484,880	$356,600	$74,100	$18,600		$54,900	$1,637,800
												NPV	**$14,836,360**

* Contingency applies to all costs except Labor.
Year 8 and 16 Major Replace values are for On-Site Generation System Electrodes $5,000 at Year 1
** Utilities Costs Inlcude New Solid Waste Hauling/Disposal costs for RV Dump Station Screen System

Discount Rate **3.50%**

City of Yelm
Planning-Level Project Cost Opinion Worksheet - Liquid Stream Alternatives
WRF Sewer Facilities Plan

Alternative 2A: SBR Ballasted Sedimentation, UV Light Disinfection
Prepared by: D. Kopchynski

Item Number	Description	Quantity	Unit	Unit Price	Total
1	Conversion to SBR Ballasted Sedimentation	1	LS	$ 1,440,000.00	$1,440,000
2	Ballasted Sedimentation Process Building	1	LS	$ 150,000.00	$150,000
3	Existing SBR Misc Work, Rails/Coatings/Piping	3	LS	$ 75,000.00	$225,000
4	SBR Process Blower Replacement	1	LS	$ 350,000.00	$350,000
5	Exsiting SBR Basin Diffuser Air Replacement	1	LS	$ 700,000.00	$700,000
6	RV Dump Station Improvements	1	LS	$ 200,000.00	$200,000
7	UV Light Disinfection for Primary Disinfection	1	LS	$ 425,000.00	$425,000
8	Chlorine Contact Basin Structural Modifications	1	LS	$ 75,000.00	$75,000
9	Secondary Liquid Hypochlorination System for Reclaimed Water Residual	1	LS	$ 100,000.00	$100,000
10	Reject Water Pump Station Replacement	1	LS	$ 150,000.00	$150,000
11	Intermediate Pump Station Upgrades	1	LS	$ 200,000.00	$200,000
12	Sludge Pump Station Improvements (Existing Plant Drain and Sludge Pump Station)	1	LS	$ 250,000.00	$250,000
13	Reclaimed Water Pump Station Major Improv.	1	LS	$ 350,000.00	$350,000
14	New Influent Chemical Feed Building	1	LS	$ 250,000.00	$250,000
15	Plant Electrical Improvements	1	LS	$ 1,800,000.00	$1,800,000
16	Plant SCADA, Controls, and Instrumentation	1	LS	$ 1,100,000.00	$1,100,000
17	Existing Tertiary Filter Internals Replacement with Backwash Upgrade	1	LS	$ 362,000.00	$362,000
18	Tertiary Filter Expansion with Backwash Upgrade	1	LS	$ 450,000.00	$450,000
18	Control Building Expansion	1	LS	$ 150,000.00	$150,000
19	New Plant Drain Pump Station	1	LS	$ 350,000.00	$350,000
20		1	LS	$ -	$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35	Contractor Installation at 10% of Equipment/Materi	1	LS	$907,700	$907,700
36	Mobilization at 5% of Equipment/Materials Costs	1	LS	$453,850	$453,850
37	Contractor Overhead and Profit at 10%	1	LS	$907,700	$907,700
38					$0
39					$0
				Subtotal	**$ 11,346,250**
			Contingency	30%	
			Sales Tax	8.7%	
			Planning Level Construction Cost		**$ 15,737,249**
			Administration, Legal	10%	$ 1,573,725
			Engineering/Permitting/Construction Management	20%	$ 3,147,450
			PROJECT TOTAL:		**$ 20,458,423**

ASSUMPTIONS:
Total project budget includes contingencies, sales tax, engineering, permitting, admin, and construction.

City of Yelm
Planning-Level Operations and Maintenance Cost Opinion Worksheet
WRF Liquid Stream Alternative 2A - Sewer Facilities Plan

Project: Current WRF Liquid Stream O&M Costs
By: D. Kopchynski

					Escalation Rates								
					Repair/Equip	**1.02**	**Labor**	**1.02**	**Chemical**	**1.01**	**Power**	**1.02**	
						Annual Costs						**5%**	
End of Year	**Avg. Daily Flow (gpd)**	**Liquid Hypo Chlorine**	**MagOH**	**Suppl. Carbon**	**Liquid Bisulfite Dechlor**	**ACH**	**Labor**	**Electrical**	**Small Repair**	**Utilities****	**Major Replace**	**Contingency***	**Annual Total**
0													
1	400,000	$13,200	$51,100	$29,200	$0	$10,300	$249,600	$94,900	$17,600	$4,400	$4,604	$11,300	$486,300
2	440,000	$14,600	$56,800	$32,500	$0	$11,400	$254,640	$106,500	$19,700	$5,000	$5,166	$12,600	$519,000
3	480,000	$16,100	$62,600	$35,800	$0	$12,600	$259,760	$118,500	$21,900	$5,500	$5,748	$14,000	$552,600
4	520,000	$17,600	$68,500	$39,200	$0	$13,700	$264,880	$131,000	$24,200	$6,100	$6,352	$15,400	$587,000
5	550,000	$18,900	$73,200	$41,800	$0	$14,700	$270,240	$141,300	$26,100	$6,600	$6,852	$16,500	$616,200
6	600,000	$20,800	$80,600	$46,100	$0	$16,200	$275,600	$157,200	$29,100	$7,300	$7,625	$18,300	$658,900
7	640,000	$22,400	$86,800	$49,600	$0	$17,400	$281,120	$171,000	$31,600	$7,900	$8,296	$19,800	$696,000
8	680,000	$24,000	$93,200	$53,300	$0	$18,700	$286,720	$185,400	$34,300	$8,600	$11,919.82	$21,500	$737,700
9	720,000	$25,700	$99,700	$57,000	$0	$20,000	$292,480	$200,200	$37,000	$9,300	$9,710	$23,000	$774,100
10	760,000	$27,400	$106,200	$60,700	$0	$21,300	$298,320	$215,500	$39,800	$10,000	$10,454	$24,600	$814,300
11	800,000	$29,100	$112,900	$64,600	$0	$22,600	$304,320	$231,400	$42,800	$10,700	$11,225	$26,300	$856,000
12	850,000	$31,200	$121,200	$69,300	$0	$24,300	$310,400	$250,800	$46,300	$11,600	$12,165	$28,400	$905,700
13	880,000	$32,600	$126,700	$72,400	$0	$25,400	$316,560	$264,800	$48,900	$12,300	$12,846	$29,800	$942,400
14	920,000	$34,400	$133,800	$76,500	$0	$26,800	$322,960	$282,400	$52,200	$13,100	$13,698	$31,700	$987,600
15	960,000	$36,300	$141,000	$80,600	$0	$28,200	$329,360	$300,600	$55,500	$13,900	$14,580	$33,600	$1,033,700
16	1,000,000	$38,200	$148,400	$84,800	$0	$29,700	$336,000	$319,400	$59,000	$14,800	$18,923.14	$35,700	$1,085,000
17	1,040,000	$40,100	$155,800	$89,100	$0	$31,200	$342,720	$338,800	$62,600	$15,700	$16,433	$37,500	$1,130,000
18	1,080,000	$42,100	$163,400	$93,400	$0	$32,700	$349,520	$358,800	$66,300	$16,600	$17,406	$39,600	$1,179,900
19	1,120,000	$44,100	$171,200	$97,800	$0	$34,300	$356,560	$379,600	$70,100	$17,600	$18,412	$41,700	$1,231,400
20	1,160,000	$46,100	$179,100	$102,400	$0	$35,900	$363,680	$401,000	$74,100	$18,600	$19,451	$43,900	$1,284,300
												NPV	**$10,325,209**
												PV	
												Discount	
												Rate	**4.50%**

* Contingency applies to all costs except Labor.
Year 8 and 16 Major Replace values are for On-Site Generation System Electrodes $2,500 Cost at Year 1
Yearly Lamp Replacment Cost Starting Year 1 at $13,090 Assumes operating at 1.16 average day flow mgd flow
** Utilities Costs Inlcude New Solid Waste Hauling/Disposal costs for RV Dump Station Screen System

Project Description:

LS2A Liquid Stream (LS) Treatment Alternative 2A: This O&M cost opinion accounts for the labor, equipment, and materials necessary for operation of the WRF under LS Treatment Alternative 2A. This is an early estimate of the O&M costs for the facility for budgetary planning purposes, and can be refined once additional facility detailed design and operations information becomes available.

Justification: Any treatment facility requires careful monitoring and maintenance, and proper staffing and budget is critical to the operation of the facility. Providing adequate budget for the ongoing labor and material costs associated with WRF operation will allow for reliable and safe facility operation.

City of Yelm
Planning-Level Cost Opinion Worksheet - Liquid Stream Alternatives
WRF Sewer Facilities Plan

Alternative 2B: Replace Existing Tertiary Filters with New Denitrification Tertiary Filtration and New UV Light Disinfection System
Prepared by: D. Kopchynski

Item Number	Description	Quantity	Unit	Unit Price	Total
1	New Tetra Denite Filtration Facility	1	LS	$ 1,160,000.00	$1,160,000
2	Tetra Denite Structural	1	LS	$ 250,000.00	$250,000
3	Tetra Denite Mechanical Support Piping	1	LS	$ 75,000.00	$75,000
4	Existing SBR Misc Repairs - Coatings/Piping	3	LS	$ 150,000.00	$450,000
5	Influent Equalization Basin and EQ/Plant Drain Pu	1	LS	$ 750,000.00	$750,000
6	SBR Process Blower Replacement	1	LS	$ 350,000.00	$350,000
7	SBR Basin Diffuser Air Replacement	1	LS	$ 700,000.00	$700,000
8	RV Dump Station Improvements	1	LS	$ 200,000.00	$200,000
9	UV Light Disinfection for Primary Disinfection	1	LS	$ 425,000.00	$425,000
10	Chlorine Contact Basin Structural Modifications	1	LS	$ 75,000.00	$75,000
11	Secondary Liquid Hypochlorination System for Reclaimed Water Residual	1	LS	$ 100,000.00	$100,000
12	Reject Water Pump Station Replacement	1	LS	$ 150,000.00	$150,000
13	Intermediate Pump Station Upgrades	1	LS	$ 200,000.00	$200,000
14	Sludge Pump Station Improvements (Existing Plant Drain and Sludge Pump Station)	1	LS	$ 250,000.00	$250,000
15	Reclaimed Water Pump Station Major Improv.	1	LS	$ 350,000.00	$350,000
16	Influent Chemical Feed Building	1	LS	$ 250,000.00	$250,000
17	Plant Electrical Improvements	1	LS	$ 1,800,000.00	$1,800,000
18	Plant SCADA, Controls, and Instrumentation	1	LS	$ 1,100,000.00	$1,100,000
19	Control Building Expansion	1	LS	$ 150,000.00	$150,000
20	New Plant Drain Pump Station	1	LS	$ 350,000.00	$350,000
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35	Contractor Installation at 10% of Equipment/Materi	1	LS	$913,500	$913,500
36	Mobilization at 5% of Equipment/Materials Costs	1	LS	$456,750	$456,750
37	Contractor Overhead and Profit at 10%	1	LS	$913,500	$913,500
38					$0
39					$0
				Subtotal	**$ 11,418,750**
			Contingency	30%	
			Sales Tax	8.7%	
			Planning Level Construction Cost		**$ 15,837,806**
			Administration, Legal	10%	$ 1,583,781
			Engineering/Permitting/Construction Management	20%	$ 3,167,561
			PROJECT TOTAL:		**$ 20,589,148**

ASSUMPTIONS:
Total project budget includes contingencies, sales tax, engineering, permitting, admin, and construction.

City of Yelm
Planning-Level Operations and Maintenance Cost Opinion Worksheet
WRF Liquid Stream Alternative 2B - Sewer Facilities Plan

Project: Current WRF Liquid Stream O&M Costs
By: D. Kopchynski

					Escalation Rates								
					Repair/Equip	**1.02**	**Labor**	**1.02**	**Chemical**	**1.01**	**Power**	**1.02**	
						Annual Costs						**5%**	
End of Year	**Avg. Daily Flow (gpd)**	**Liquid Hypo Chlorine**	**MagOH**	**Suppl. Carbon**	**Liquid Bisulfite Dechlor**	**ACH**	**Labor**	**Electrical**	**Small Repair**	**Utilities**	**Major Replace**	**Contingency***	**Annual Total**
0													
1	400,000	$13,200	$65,700	$29,200	$0	$10,300	$332,800	$94,900	$17,600	$4,400	$4,604	$12,000	$584,800
2	440,000	$14,600	$73,000	$32,500	$0	$11,400	$339,520	$106,500	$19,700	$5,000	$5,166	$13,400	$620,800
3	480,000	$16,100	$80,500	$35,800	$0	$12,600	$346,320	$118,500	$21,900	$5,500	$5,748	$14,900	$657,900
4	520,000	$17,600	$88,000	$39,200	$0	$13,700	$353,200	$131,000	$24,200	$6,100	$6,352	$16,400	$695,800
5	550,000	$18,900	$94,100	$41,800	$0	$14,700	$360,240	$141,300	$26,100	$6,600	$6,852	$17,600	$728,200
6	600,000	$20,800	$103,600	$46,100	$0	$16,200	$367,440	$157,200	$29,100	$7,300	$7,625	$19,400	$774,800
7	640,000	$22,400	$111,600	$49,600	$0	$17,400	$374,800	$171,000	$31,600	$7,900	$8,296	$21,000	$815,600
8	680,000	$24,000	$119,800	$53,300	$0	$18,700	$382,320	$185,400	$34,300	$8,600	$11,920	$22,900	$861,300
9	720,000	$25,700	$128,100	$57,000	$0	$20,000	$390,000	$200,200	$37,000	$9,300	$9,710	$24,400	$901,500
10	760,000	$27,400	$136,600	$60,700	$0	$21,300	$397,760	$215,500	$39,800	$10,000	$10,454	$26,100	$945,700
11	800,000	$29,100	$145,200	$64,600	$0	$22,600	$405,760	$231,400	$42,800	$10,700	$11,225	$27,900	$991,300
12	850,000	$31,200	$155,800	$69,300	$0	$24,300	$413,840	$250,800	$46,300	$11,600	$12,165	$30,100	$1,045,500
13	880,000	$32,600	$162,900	$72,400	$0	$25,400	$422,080	$264,800	$48,900	$12,300	$12,846	$31,700	$1,086,000
14	920,000	$34,400	$172,000	$76,500	$0	$26,800	$430,560	$282,400	$52,200	$13,100	$13,698	$33,600	$1,135,300
15	960,000	$36,300	$181,300	$80,600	$0	$28,200	$439,200	$300,600	$55,500	$13,900	$14,580	$35,600	$1,185,800
16	1,000,000	$38,200	$190,700	$84,800	$0	$29,700	$447,920	$319,400	$59,000	$14,800	$18,923	$37,800	$1,241,300
17	1,040,000	$40,100	$200,300	$89,100	$0	$31,200	$456,880	$338,800	$62,600	$15,700	$16,433	$39,800	$1,291,000
18	1,080,000	$42,100	$210,100	$93,400	$0	$32,700	$466,080	$358,800	$66,300	$16,600	$17,406	$41,900	$1,345,400
19	1,120,000	$44,100	$220,100	$97,800	$0	$34,300	$475,360	$379,600	$70,100	$17,600	$18,412	$44,200	$1,401,600
20	1,160,000	$46,100	$230,200	$102,400	$0	$35,900	$484,880	$401,000	$74,100	$18,600	$19,451	$46,400	$1,459,100
												NPV	**$12,000,028**

* Contingency applies to all costs except Labor.
Year 8 and 16 Major Replace values are for On-Site Generation System Electrodes $2,500 Cost at Year 1
Yearly Lamp Replacment Cost Starting Year 1 at $13,090 Assumes operating at 1.16 average day flow mgd flow
** Utilities Costs Inlcude New Solid Waste Hauling/Disposal costs for RV Dump Station Screen System

Discount Rate **4.50%**

City of Yelm
Planning-Level Cost Opinion Worksheet Liquid Stream Alternatives
WRF Sewer Facilities Plan

Alternative: 2C: Add Another SBR Tank, Convert to UV Light Disinfection
Prepared by: D. Kopchynski

Item Number	Description	Quantity	Unit	Unit Price	Total
1	New SBR Tank Equipment	1	LS	$ 700,000.00	$700,000
2	New SBR Tank Structural	1	LS	$ 500,000.00	$500,000
3	New SBR Tank Mechanical Piping	1	LS	$ 100,000.00	$100,000
4	Existing SBR Misc Work - Rails, Coatings/Piping	3	LS	$ 150,000.00	$450,000
5	Influent Equalization Basin and EQ/Plant Drain Pump Stations	1	LS	$ 500,000.00	$500,000
6	SBR Process Blower Replacement	1	LS	$ 350,000.00	$350,000
7	Existing SBR Basins Diffuser Air Replacement	1	LS	$ 700,000.00	$700,000
8	RV Dump Station Improvements	1	LS	$ 200,000.00	$200,000
9	UV Light Disinfection for Primary Disinfection	1	LS	$ 425,000.00	$425,000
10	Chlorine Contact Basin Structural Modifications	1	LS	$ 75,000.00	$75,000
11	Secondary Liquid Hypochlorination System for Reclaimed Water Residual	1	LS	$ 100,000.00	$100,000
12	Reject Water Pump Station Replacement	1	LS	$ 150,000.00	$150,000
13	Intermediate Pump Station Upgrades	1	LS	$ 200,000.00	$200,000
14	Sludge Pump Station Improvements (Existing Plant Drain and Sludge Pump Station)	1	LS	$ 250,000.00	$250,000
15	Reclaimed Water Pump Station Major Improv.	1	LS	$ 350,000.00	$350,000
16	Influent Chemical Feed Building	1	LS	$ 250,000.00	$250,000
17	Plant Electrical Improvements	1	LS	$ 1,800,000.00	$1,800,000
18	Plant SCADA, Controls, and Instrumentation	1	LS	$ 1,100,000.00	$1,100,000
19	Existing Tertiary Filter Internals Replacement with Backwash Upgrade	1	LS	$ 362,000.00	$362,000
20	Tertiary Filter Expansion with Backwash Upgrade	1	LS	$ 450,000.00	$450,000
21	Control Building Expansion	1	LS	$ 150,000.00	$150,000
22	New Plant Drain Pump Station	1	LS	$ 350,000.00	$350,000
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35	Contractor Installation at 10% of Equipment/Materi	1	LS	$951,200	$951,200
36	Mobilization at 5% of Equipment/Materials Costs	1	LS	$475,600	$475,600
37	Contractor Overhead and Profit at 10%	1	LS	$951,200	$951,200
38					$0
39					$0
				Subtotal	**$ 11,890,000**
			Contingency	30%	
			Sales Tax	8.7%	
			Planning Level Construction Cost		**$ 16,491,430**
			Administration, Legal	10%	$ 1,649,143
			Engineering/Permitting/Construction Management	20%	$ 3,298,286
				PROJECT TOTAL:	**$ 21,438,859**

ASSUMPTIONS:
Total project budget includes contingencies, sales tax, engineering, permitting, admin, and construction.

City of Yelm
Planning-Level Operations and Maintenance Cost Opinion Worksheet
WRF Liquid Stream Alternative 2C - Sewer Facilities Plan

Project: Current WRF Liquid Stream O&M Costs
By: D. Kopchynski

					Escalation Rates								
					Repair/Equip	**1.02**	**Labor**	**1.02**	**Chemical**	**1.01**	**Power**	**1.02**	
						Annual Costs						**5%**	
End of Year	**Avg. Daily Flow (gpd)**	**Liquid Hypo Chlorine**	**MagOH**	**Suppl. Carbon**	**Liquid Bisulfite Dechlor**	**ACH**	**Labor**	**Electrical**	**Small Repair**	**Utilities**	**Major Replace**	**Contingency***	**Annual Total**
0													
1	400,000	$13,200	$112,500	$38,000	$0	$27,800	$332,800	$87,600	$17,600	$4,400	$4,604	$15,300	$653,900
2	440,000	$14,600	$124,900	$42,200	$0	$30,900	$339,520	$98,300	$19,700	$5,000	$5,166	$17,100	$697,400
3	480,000	$16,100	$137,700	$46,500	$0	$34,000	$346,320	$109,400	$21,900	$5,500	$5,748	$18,900	$742,100
4	520,000	$17,600	$150,600	$50,900	$0	$37,200	$353,200	$120,900	$24,200	$6,100	$6,352	$20,700	$787,800
5	550,000	$18,900	$160,900	$54,400	$0	$39,700	$360,240	$130,400	$26,100	$6,600	$6,852	$22,200	$826,300
6	600,000	$20,800	$177,300	$59,900	$0	$43,800	$367,440	$145,100	$29,100	$7,300	$7,625	$24,600	$883,000
7	640,000	$22,400	$191,000	$64,500	$0	$47,200	$374,800	$157,900	$31,600	$7,900	$8,296	$26,600	$932,200
8	680,000	$24,000	$205,000	$69,200	$0	$50,600	$382,320	$171,100	$34,300	$8,600	$11,920	$28,800	$985,900
9	720,000	$25,700	$219,200	$74,000	$0	$54,100	$390,000	$184,800	$37,000	$9,300	$9,710	$30,700	$1,034,600
10	760,000	$27,400	$233,700	$78,900	$0	$57,700	$397,760	$199,000	$39,800	$10,000	$10,454	$32,900	$1,087,700
11	800,000	$29,100	$248,400	$83,900	$0	$61,300	$405,760	$213,600	$42,800	$10,700	$11,225	$35,100	$1,141,900
12	850,000	$31,200	$266,600	$90,000	$0	$65,800	$413,840	$231,500	$46,300	$11,600	$12,165	$37,800	$1,206,900
13	880,000	$32,600	$278,700	$94,200	$0	$68,800	$422,080	$244,500	$48,900	$12,300	$12,846	$39,700	$1,254,700
14	920,000	$34,400	$294,300	$99,400	$0	$72,700	$430,560	$260,700	$52,200	$13,100	$13,698	$42,100	$1,313,200
15	960,000	$36,300	$310,200	$104,800	$0	$76,600	$439,200	$277,500	$55,500	$13,900	$14,580	$44,500	$1,373,100
16	1,000,000	$38,200	$326,300	$110,200	$0	$80,600	$447,920	$294,800	$59,000	$14,800	$18,923	$47,200	$1,438,000
17	1,040,000	$40,100	$342,800	$115,800	$0	$84,600	$456,880	$312,700	$62,600	$15,700	$16,433	$49,600	$1,497,300
18	1,080,000	$42,100	$359,500	$121,400	$0	$88,800	$466,080	$331,200	$66,300	$16,600	$17,406	$52,200	$1,561,600
19	1,120,000	$44,100	$376,600	$127,200	$0	$93,000	$475,360	$350,400	$70,100	$17,600	$18,412	$54,900	$1,627,700
20	1,160,000	$46,100	$393,900	$133,000	$0	$97,200	$484,880	$370,100	$74,100	$18,600	$19,451	$57,700	$1,695,100
												NPV	**$13,767,940**

* Contingency applies to all costs except Labor.
Year 8 and 16 Major Replace values are for On-Site Generation System Electrodes $2,500 Cost at Year 1
Yearly Lamp Replacment Cost Starting Year 1 at $13,090 Assumes operating at 1.16 average day flow mgd flow
** Utilities Costs Inlcude New Solid Waste Hauling/Disposal costs for RV Dump Station Screen System

Discount Rate **4.50%**

City of Yelm
Planning-Level Cost Opinion Worksheet - Liquid Stream Alternatives
WRF Sewer Facilities Plan

Alternative: 3 Complete Process Renovation, Conversion to MBR, UV Light Disinfection
Prepared by: D. Kopchynski

Item Number	Description	Quantity	Unit	Unit Price	Total
1	Equipment To Convert SBRs to MBR System	1	LS	$ 2,400,000.00	$2,400,000
2	MBR Process Building	1	LS	$ 300,000.00	$300,000
3	MBR Fine Screens Structural	1	LS	$ 350,000.00	$350,000
4	MBR Screens - Equipment	1	LS	$ 350,000.00	$350,000
5	Existing SBR Misc Rehab - Rails,Coatings/Piping	3	LS	$ 150,000.00	$450,000
6	SBR Process Blower Replacement	1	LS	$ 350,000.00	$350,000
7	RV Dump Station Improvements	1	LS	$ 200,000.00	$200,000
8	UV Light Disinfection for Primary Disinfection	1	LS	$ 495,000.00	$495,000
9	Chlorine Contact Basin Structural Modifications	1	LS	$ 75,000.00	$75,000
10	Secondary Liquid Hypochlorination System for Reclaimed Water Residual	1	LS	$ 100,000.00	$100,000
11	Sludge Pump Station Improvements (Existing Plant Drain and Sludge Pump Station)	1	LS	$ 250,000.00	$250,000
12	Reclaimed Water Pump Station Major Improv.	1	LS	$ 350,000.00	$350,000
13	Influent Chemical Feed Building	1	LS	$ 250,000.00	$250,000
14	Plant Electrical Improvements	1	LS	$ 1,800,000.00	$1,800,000
15	Plant SCADA, Controls, and Instrumentation	1	LS	$ 1,100,000.00	$1,100,000
16	Control Building Expansion	1	LS	$ 150,000.00	$150,000
17	SBR Tank Misc Work - Coatings, Valves/Piping, Crane Lifting System for MBR Modules, Divider Walls, Gates	3	LS	$ 250,000.00	$750,000
18	New Plant Drain Pump Station	1	LS	$ 350,000.00	$350,000
19	Tank Crane Lifting System for MBR	1	LS	$ 100,000.00	$100,000
20	Specialized Maintenance of Plant Operations, e.g. Pump Arounds to install fine screen system)	1	LS	$ 150,000.00	$150,000
21	Reject Water Pump Station Replacement	1	LS	$ 150,000.00	$150,000
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35	Contractor Installation at 10% of Equipment/Materials Cost	1	LS	$1,047,000	$1,047,000
36	Mobilization at 5% of Equipment/Materials Costs	1	LS	$523,500	$523,500
37	Contractor Overhead and Profit at 10%	1	LS	$1,047,000	$1,047,000
38					$0
39					$0
				Subtotal	**$ 13,087,500**
				Contingency 30%	
				Sales Tax 8.7%	
				Planning Level Construction Cost	**$ 18,152,363**
				Administration, Legal 10%	$ 1,815,236
				Engineering/Permitting/Construction Management 20%	$ 3,630,473
				PROJECT TOTAL:	**$ 23,598,071**

ASSUMPTIONS:
Total project budget includes contingencies, sales tax, engineering, permitting, admin, and construction.

City of Yelm
Planning-Level Operations and Maintenance Cost Opinion Worksheet
WRF Liquid Stream Alternative 3 - Sewer Facilities Plan

Project: Current WRF Liquid Stream O&M Costs
By: D. Kopchynski

Escalation Rates		Labor		Chemical		Power	
Repair/Equip	1.02		1.02		1.01		1.02

					Annual Costs							5%	
End of Year	Avg. Daily Flow (gpd)	Liquid Hypo Chlorine	MagOH	Suppl. Carbon	Liquid Bisulfite Dechlor	ACH	Labor	Electrical	Small Repair	Utilities**	Major Replace	Contingency*	Annual Total
0													
1	400,000	$13,900	$62,800	$29,200	$0	$0	$249,600	$97,900	$19,000	$5,900	$4,604	$11,700	$494,700
2	440,000	$15,500	$69,800	$32,500	$0	$0	$254,640	$109,800	$21,300	$6,600	$5,166	$13,100	$528,500
3	480,000	$17,000	$76,900	$35,800	$0	$0	$259,760	$122,200	$23,700	$7,300	$5,748	$14,500	$563,000
4	520,000	$18,600	$84,100	$39,200	$0	$0	$264,880	$135,000	$26,200	$8,100	$6,352	$15,900	$598,400
5	550,000	$19,900	$89,900	$41,800	$0	$0	$270,240	$145,600	$28,300	$8,700	$6,852	$17,100	$628,400
6	600,000	$21,900	$99,000	$46,100	$0	$0	$275,600	$162,100	$31,500	$9,700	$7,625	$18,900	$672,500
7	640,000	$23,600	$106,700	$49,600	$0	$0	$281,120	$176,300	$34,200	$10,600	$8,296	$20,500	$711,000
8	680,000	$25,300	$114,500	$53,300	$0	$0	$286,720	$191,100	$37,100	$11,500	$11,920	$22,300	$753,800
9	720,000	$27,100	$122,400	$57,000	$0	$0	$292,480	$206,400	$40,100	$12,400	$9,710	$23,800	$791,400
10	760,000	$28,900	$130,500	$60,700	$0	$0	$298,320	$222,200	$43,100	$13,300	$193,303.51	$34,700	$1,025,100
11	800,000	$30,700	$138,700	$64,600	$0	$0	$304,320	$238,500	$46,300	$14,300	$11,225	$27,300	$876,000
12	850,000	$32,900	$148,900	$69,300	$0	$0	$310,400	$258,500	$50,200	$15,500	$12,165	$29,400	$927,300
13	880,000	$34,400	$155,700	$72,400	$0	$0	$316,560	$273,000	$53,000	$16,300	$12,846	$30,900	$965,200
14	920,000	$36,400	$164,400	$76,500	$0	$0	$322,960	$291,100	$56,500	$17,400	$13,698	$32,800	$1,011,800
15	960,000	$38,300	$173,200	$80,600	$0	$0	$329,360	$309,800	$60,200	$18,500	$14,580	$34,800	$1,059,400
16	1,000,000	$40,300	$182,300	$84,800	$0	$0	$336,000	$329,200	$63,900	$19,700	$18,923	$37,000	$1,112,200
17	1,040,000	$42,300	$191,400	$89,100	$0	$0	$342,720	$349,200	$67,800	$20,900	$16,433	$38,900	$1,158,800
18	1,080,000	$44,400	$200,800	$93,400	$0	$0	$349,520	$369,900	$71,800	$22,100	$17,406	$41,000	$1,210,400
19	1,120,000	$46,500	$210,300	$97,800	$0	$0	$356,560	$391,200	$76,000	$23,400	$18,412	$43,200	$1,263,400
20	1,160,000	$48,600	$220,000	$102,400	$0	$0	$363,680	$413,300	$80,200	$24,700	$202,300.21	$54,600	$1,509,800
												NPV	**$10,763,106**

* Contingency applies to all costs except Labor.

Year 8 and 16 Major Replace values are for On-Site Generation System Electrodes $2,500 Cost at Year 1

Yearly Lamp Replacment Cost Starting Year 1 at $13,090 Assumes operating at 1.16 average day flow mgd flow

Year 10 and 20 Membranes Replacement $150,000 Cost at Year 1

Discount Rate **4.50%**

** Utilities Costs Inlcude New Solid Waste Hauling/Disposal costs for MBR Fine Screens and RV Dump Station Screen System

City of Yelm
Planning-Level Cost Opinion Worksheet - Solids Stream Alternatives
WRF Sewer Facilities Plan

Alternative: SS 1: Continue Sludge Thickening Only
Prepared by: D. Kopchynski

Item Number	Description	Quantity	Unit	Unit Price	Total
1	Replace Gravity Belt Thickener with New Drum Thickener	1	LS	$ 150,000.00	$150,000
2	Solids Handling Building Coatings and Repairs	1	LS	$ 100,000.00	$100,000
3	Thickening Polymer System Upgrades	1	LS	$ 100,000.00	$100,000
4	Sludge Storage Tank Blowers	1	LS	$ 50,000.00	$50,000
5	Sludge Storage Tank Repairs	1	LS	$ 50,000.00	$50,000
6	Temporary Thickening	1	LS	$ 50,000.00	$50,000
7	Solids Handling Building Structural Modifications	1	LS	$ 150,000.00	$150,000
8	Electrical Improvements	1	LS	$ 150,000.00	$150,000
9	Controls	1	LS	$ 75,000.00	$75,000
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
					$0
	Contractor Installation at 10% of Equipment/Materia	1	LS	$87,500	$87,500
	Mobilization at 5% of Equipment/Materials Costs	1	LS	$43,750	$43,750
	Contractor Overhead and Profit at 10%	1	LS	$87,500	$87,500
					$0
					$0

	Subtotal	**$**	**1,093,750**
Contingency	30%		
Sales Tax	8.7%		
Planning Level Construction Cost		**$**	**1,517,031**
Administration, Legal	10%	$	151,703
Engineering/Permitting/Construction Management	20%	$	303,406
PROJECT TOTAL:		**$**	**1,972,141**

ASSUMPTIONS:
Total project budget includes contingencies, sales tax, engineering, permitting, admin, and construction.

City of Yelm
Planning-Level Operations and Maintenance Cost Opinion Worksheet
Solids Stream Alternative 1 - Sewer Facilities Plan

Project: Alternative 1 - O&M Costs
Prepared by: D. Kopchynski

									Inflation Rates											
									Repair/Equip	1.02	Disposal	1.01	Labor	1.02	Chemical	1.02	Power/Util	1.02		
											Annual Costs									5%	
End of Year	Avg. Daily Flow (gpd)	WAS Produced (dry tons)	Septage Produced (dry tons)	Untreaded Thickened WAS Sludge Disposal	Untreated, Dewatered WAS Sludge Disposal	Untreated Septage Sludge Disposal	Untreated, Dewatered Septage / WAS Sludge Disposal	Class A, Dewatered Septage / WAS Sludge Disposal	Polymer for Thickening	Polymer for Dewatering	Lystek Process Potassium Hydroxide	Labor	Electrical	Small Repair	Utilities	Major Replace	Contingency*	Annual Total
0																		
1	400,000	59	28	$87,600	$0	$109,500	$0	$0	$4,400	$0	$0	$62,400	$13,600	$8,800	$2,200		$11,000	$299,500
2	440,000	65	31	$97,400	$0	$121,700	$0	$0	$4,900	$0	$0	$63,660	$15,300	$9,900	$2,500		$12,300	$327,700
3	480,000	71	34	$107,300	$0	$134,100	$0	$0	$5,400	$0	$0	$64,940	$17,000	$11,000	$2,800		$13,500	$356,100
4	520,000	77	36	$117,400	$0	$146,700	$0	$0	$5,900	$0	$0	$66,220	$18,800	$12,100	$3,100		$14,800	$385,100
5	550,000	82	39	$125,400	$0	$156,700	$0	$0	$6,300	$0	$0	$67,560	$20,300	$13,100	$3,300		$15,800	$408,500
6	600,000	89	42	$138,200	$0	$172,700	$0	$0	$7,000	$0	$0	$68,900	$22,500	$14,600	$3,700		$17,400	$445,000
7	640,000	95	45	$148,800	$0	$186,000	$0	$0	$7,500	$0	$0	$70,280	$24,500	$15,800	$4,000		$18,800	$475,700
8	680,000	101	48	$159,700	$0	$199,600	$0	$0	$8,000	$0	$0	$71,680	$26,600	$17,200	$4,300		$20,200	$507,300
9	720,000	107	50	$170,800	$0	$213,500	$0	$0	$8,600	$0	$0	$73,120	$28,700	$18,500	$4,700		$21,600	$539,600
10	760,000	113	53	$182,100	$0	$227,600	$0	$0	$9,200	$0	$0	$74,580	$30,900	$19,900	$5,000		$23,100	$572,400
11	800,000	119	56	$193,600	$0	$242,000	$0	$0	$9,700	$0	$0	$76,080	$33,200	$21,400	$5,400		$24,600	$606,000
12	850,000	126	60	$207,700	$0	$259,700	$0	$0	$10,400	$0	$0	$77,600	$35,900	$23,200	$5,800		$26,400	$646,700
13	880,000	131	62	$217,200	$0	$271,500	$0	$0	$10,900	$0	$0	$79,140	$37,900	$24,500	$6,200		$27,600	$675,000
14	920,000	137	64	$229,400	$0	$286,700	$0	$0	$11,500	$0	$0	$80,740	$40,400	$26,100	$6,600		$29,200	$710,700
15	960,000	142	67	$241,700	$0	$302,100	$0	$0	$12,100	$0	$0	$82,340	$43,000	$27,800	$7,000		$30,800	$746,900
16	1,000,000	148	70	$254,300	$0	$317,900	$0	$0	$12,800	$0	$0	$84,000	$45,700	$29,500	$7,400		$32,400	$784,000
17	1,040,000	154	73	$267,100	$0	$333,900	$0	$0	$13,400	$0	$0	$85,680	$48,500	$31,300	$7,900		$34,100	$821,900
18	1,080,000	160	76	$280,200	$0	$350,200	$0	$0	$14,100	$0	$0	$87,380	$51,400	$33,200	$8,300		$35,800	$860,600
19	1,120,000	166	78	$293,400	$0	$366,800	$0	$0	$14,700	$0	$0	$89,140	$54,300	$35,100	$8,800		$37,500	$899,800
20	1,160,000	172	81	$307,000	$0	$383,700	$0	$0	$15,400	$0	$0	$90,920	$57,400	$37,100	$9,300		$39,300	$940,200
																	NPW	**$7,992,354**

* Contingency applies to all costs except Labor.

Interest Rate **3.50%**

$477,800

City of Yelm
Planning-Level Cost Opinion Worksheet - Solids Stream Alternatives
WRF Sewer Facilities Plan

Alternative: SS 2: Replace Gravity Belt Thickener with Drum Thickener/Dewatering Screw Press
Prepared by: D. Kopchynski

Item Number	Description	Quantity	Unit	Unit Price	Total
1	New Dewatering Screw Press with Drum Thickener	1	LS	$ 300,000.00	$300,000
2	Solids Handling Building Modifications	1	LS	$ 250,000.00	$250,000
3	Polymer System Upgrades	1	LS	$ 100,000.00	$100,000
4	Sludge Storage Tank Repairs	1	LS	$ 50,000.00	$50,000
5	Temporary Thickening	1	LS	$ 100,000.00	$100,000
6	Dewatered Sludge Load Off Equipment	1	LS	$ 150,000.00	$150,000
7	Sludge Storage Tank Blowers	1	LS	$ 50,000.00	$50,000
8	Electrical Improvements	1	LS	$ 250,000.00	$250,000
9	Controls	1	LS	$ 150,000.00	$150,000
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
					$0
	Contractor Installation at 10% of Equipment/Materia	1	LS	$140,000	$140,000
	Mobilization at 5% of Equipment/Materials Costs	1	LS	$70,000	$70,000
	Contractor Overhead and Profit at 10%	1	LS	$140,000	$140,000
					$0
					$0
				Subtotal	**$ 1,750,000**
				Contingency 30%	
				Sales Tax 8.7%	
				Planning Level Construction Cost	**$ 2,427,250**
				Administration, Legal 10%	$ 242,725
				Engineering/Permitting/Construction Management 20%	$ 485,450
				PROJECT TOTAL:	**$ 3,155,425**

ASSUMPTIONS:
Total project budget includes contingencies, sales tax, engineering, permitting, admin, and construction.

City of Yelm
Planning-Level Operations and Maintenance Cost Opinion Worksheet
Solids Stream Alternative 2 - Sewer Facilities Plan

Project: Alternative 1 - O&M Costs
Prepared by: D. Kopchynski

								Inflation Rates Repair/Equip	1.02	Disposal	1.01	Labor	1.02	Chemical	1.02	Power/Util	1.02		
										Annual Costs								5%	
End of Year	Avg. Daily Flow (gpd)	WAS Produced (dry tons)	Septage Produced (dry tons)	Untreaded Thickened WAS Sludge Disposal	Untreated, Dewatered WAS Sludge Disposal	Untreated Septage Sludge Disposal	Untreated, Dewatered Septage / WAS Sludge Disposal	Class A, Dewatered Septage / WAS Sludge Disposal	Polymer for Thickening	Polymer for Dewatering	Lystek Process Potassium Hydroxide	Labor	Electrical	Small Repair	Utilities	Major Replace	Contingency*	Annual Total
0																			
1	400,000	59	28	$0	$0	$109,500	$39,600	$0	$0	$2,400	$0	$62,400	$13,600	$8,800	$2,200		$8,600	$247,100
2	440,000	65	31	$0	$0	$121,700	$44,000	$0	$0	$2,700	$0	$63,660	$15,300	$9,900	$2,500		$9,600	$269,400
3	480,000	71	34	$0	$0	$134,100	$48,500	$0	$0	$3,000	$0	$64,940	$17,000	$11,000	$2,800		$10,600	$292,000
4	520,000	77	36	$0	$0	$146,700	$53,100	$0	$0	$3,200	$0	$66,220	$18,800	$12,100	$3,100		$11,600	$314,900
5	550,000	82	39	$0	$0	$156,700	$56,700	$0	$0	$3,400	$0	$67,560	$20,300	$13,100	$3,300		$12,400	$333,500
6	600,000	89	42	$0	$0	$172,700	$62,400	$0	$0	$3,800	$0	$68,900	$22,500	$14,600	$3,700		$13,700	$362,300
7	640,000	95	45	$0	$0	$186,000	$67,300	$0	$0	$4,100	$0	$70,280	$24,500	$15,800	$4,000		$14,700	$386,700
8	680,000	101	48	$0	$0	$199,600	$72,200	$0	$0	$4,400	$0	$71,680	$26,600	$17,200	$4,300		$15,800	$411,800
9	720,000	107	50	$0	$0	$213,500	$77,200	$0	$0	$4,700	$0	$73,120	$28,700	$18,500	$4,700		$16,900	$437,400
10	760,000	113	53	$0	$0	$227,600	$82,300	$0	$0	$5,000	$0	$74,580	$30,900	$19,900	$5,000		$18,100	$463,400
11	800,000	119	56	$0	$0	$242,000	$87,500	$0	$0	$5,300	$0	$76,080	$33,200	$21,400	$5,400		$19,300	$490,200
12	850,000	126	60	$0	$0	$259,700	$93,900	$0	$0	$5,700	$0	$77,600	$35,900	$23,200	$5,800		$20,700	$522,500
13	880,000	131	62	$0	$0	$271,500	$98,200	$0	$0	$5,900	$0	$79,140	$37,900	$24,500	$6,200		$21,700	$545,100
14	920,000	137	64	$0	$0	$286,700	$103,600	$0	$0	$6,300	$0	$80,740	$40,400	$26,100	$6,600		$22,900	$573,400
15	960,000	142	67	$0	$0	$302,100	$109,200	$0	$0	$6,600	$0	$82,340	$43,000	$27,800	$7,000		$24,200	$602,300
16	1,000,000	148	70	$0	$0	$317,900	$114,900	$0	$0	$6,900	$0	$84,000	$45,700	$29,500	$7,400		FALSE	$606,300
17	1,040,000	154	73	$0	$0	$333,900	$120,700	$0	$0	$7,300	$0	$85,680	$48,500	$31,300	$7,900		$26,800	$662,100
18	1,080,000	160	76	$0	$0	$350,200	$126,600	$0	$0	$7,600	$0	$87,380	$51,400	$33,200	$8,300		$28,100	$692,800
19	1,120,000	166	78	$0	$0	$366,800	$132,600	$0	$0	$8,000	$0	$89,140	$54,300	$35,100	$8,800		$29,500	$724,300
20	1,160,000	172	81	$0	$0	$383,700	$138,700	$0	$0	$8,400	$0	$90,920	$57,400	$37,100	$9,300		$30,900	$756,500
																	NPW	**$6,462,000**

* Contingency applies to all costs except Labor.

Interest Rate **3.50%**

City of Yelm
Planning-Level Cost Opinion Worksheet - Solids Stream Alternatives
WRF Sewer Facilities Plan

Alternative: SS 3: Convert to Lystek Class A System, Capable of Accepting Septage along with WAS
Prepared by: D. Kopchynski

Item Number	Description	Quantity	Unit	Unit Price	Total
1	Lystek Class A System (Includes new drum thickener and screw press)	1	LS	$ 1,800,000.00	$1,800,000
2	Solids Handling Building Modifications	1	LS	$ 250,000.00	$250,000
3	Polymer System Upgrades	1	LS	$ 100,000.00	$100,000
4	Sludge Storage Tank Repairs	1	LS	$ 50,000.00	$50,000
5	Temporary Thickening	1	LS	$ 100,000.00	$100,000
5	Dewatered Sludge Load Off Equipment	1	LS	$ 150,000.00	$150,000
6	Covered Biosolids Storage Pond	1	LS	$ 250,000.00	$250,000
7	Sludge Storage Tank Blowers	1	LS	$ 50,000.00	$50,000
8	NaOH System Upgrades	1	LS	$ 50,000.00	$50,000
9	Electrical Improvements	1	LS	$ 300,000.00	$300,000
10	Controls	1	LS	$ 200,000.00	$200,000
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
	Contractor Installation at 10% of Equipment/Materia	1	LS	$330,000	$330,000
	Mobilization at 5% of Equipment/Materials Costs	1	LS	$165,000	$165,000
	Contractor Overhead and Profit at 10%	1	LS	$330,000	$330,000

Subtotal		**$**	**4,125,000**
Contingency	30%		
Sales Tax	8.7%		
Planning Level Construction Cost		**$**	**5,721,375**
Administration, Legal	10%	$	572,138
Engineering/Permitting/Construction Management	20%	$	1,144,275
PROJECT TOTAL:		**$**	**7,437,788**

ASSUMPTIONS:
Total project budget includes contingencies, sales tax, engineering, permitting, admin, and construction.

City of Yelm
Planning-Level Operations and Maintenance Cost Opinion Worksheet
Solids Stream Alternative 3 - Sewer Facilities Plan

Project: Alternative 3 - O&M Costs
Prepared by: D. Kopchynski

							Inflation Rates Repair/Equip	1.02	Disposal	1.01	Labor	1.02	Chemical	1.02	Power/Util	1.02		
									Annual Costs								5%	
End of Year	Avg. Daily Flow (gpd)	WAS Produced (dry tons)	Septage Produced (dry tons)	Untreaded Thickened WAS Sludge Disposal	Untreated, Dewatered WAS Sludge Disposal	Untreated Septage Sludge Disposal	Untreated, Dewatered Septage / WAS Sludge Disposal	Class A, Dewatered Septage / WAS Sludge Shipping Cost	Polymer for Thickening	Polymer for Dewatering	Lystek Process Alkali	Labor	Electrical**	Small Repair	Utilities***	Major Replace	Contingency*	Annual Total
0																		
1	400,000	99	28	$0	$0	$0	$0	$8,500	$0	$4,000	$6,400	$0	$13,700	$8,800	$3,800		$1,600	$46,800
2	440,000	109	31	$0	$0	$0	$0	$9,400	$0	$4,400	$7,100	$63,660	$15,400	$9,900	$4,200		$1,800	$115,900
3	480,000	119	34	$0	$0	$0	$0	$10,400	$0	$4,900	$7,900	$64,940	$17,000	$11,000	$4,700		$2,000	$122,900
4	520,000	128	36	$0	$0	$0	$0	$11,400	$0	$5,300	$8,800	$66,220	$18,800	$12,100	$5,200		$2,200	$130,100
5	550,000	136	39	$0	$0	$0	$0	$12,100	$0	$5,700	$9,500	$67,560	$20,300	$13,100	$5,700		$2,300	$136,300
6	600,000	148	42	$0	$0	$0	$0	$13,400	$0	$6,300	$10,500	$68,900	$22,500	$14,600	$6,300		$2,600	$145,100
7	640,000	158	45	$0	$0	$0	$0	$14,400	$0	$6,800	$11,400	$70,280	$24,500	$15,800	$6,800		$2,800	$152,800
8	680,000	168	48	$0	$0	$0	$0	$15,500	$0	$7,300	$12,400	$71,680	$26,600	$17,200	$7,400		$3,000	$161,100
9	720,000	178	50	$0	$0	$0	$0	$16,500	$0	$7,800	$13,400	$73,120	$28,700	$18,500	$7,900		$3,200	$169,200
10	760,000	188	53	$0	$0	$0	$0	$17,600	$0	$8,300	$14,400	$74,580	$30,900	$19,900	$8,500		$3,500	$177,700
11	800,000	198	56	$0	$0	$0	$0	$18,700	$0	$8,800	$15,500	$76,080	$33,200	$21,400	$9,100		$3,700	$186,500
12	850,000	210	60	$0	$0	$0	$0	$20,100	$0	$9,400	$16,800	$77,600	$35,900	$23,200	$9,900		$4,000	$196,900
13	880,000	217	62	$0	$0	$0	$0	$21,000	$0	$9,800	$17,700	$79,140	$37,900	$24,500	$10,400		$4,200	$204,700
14	920,000	227	64	$0	$0	$0	$0	$22,200	$0	$10,400	$18,900	$80,740	$40,400	$26,100	$11,200		$4,500	$214,500
15	960,000	237	67	$0	$0	$0	$0	$23,400	$0	$11,000	$20,100	$82,340	$43,000	$27,800	$11,900		$4,800	$224,400
16	1,000,000	247	70	$0	$0	$0	$0	$24,600	$0	$11,500	$21,300	$84,000	$45,700	$29,500	$12,600		$5,000	$234,200
17	1,040,000	257	73	$0	$0	$0	$0	$25,800	$0	$12,100	$22,600	$85,680	$48,500	$31,300	$13,400		$5,300	$244,700
18	1,080,000	267	76	$0	$0	$0	$0	$27,100	$0	$12,700	$24,000	$87,380	$51,400	$33,200	$14,100		$5,600	$255,500
19	1,120,000	277	78	$0	$0	$0	$0	$28,400	$0	$13,300	$25,300	$89,140	$54,300	$35,100	$14,900		$5,900	$266,400
20	1,160,000	287	81	$0	$0	$0	$0	$29,700	$0	$13,900	$26,800	$90,920	$57,400	$37,100	$15,800		$6,300	$278,000
																	NPW	**$2,445,700**

* Contingency applies to all costs except Labor.
** Includes additional costs to power Lystek mixing and pumping equipment
*** Includes natural gas costs to power Lystek Steam Generator

Interest Rate **3.50%**

$3

City of Yelm
Planning-Level Project Cost Opinion Worksheet - Liquid Stream Alternatives
WRF Sewer Facilities Plan

Alternative 2A: Phase I - Immediate Upgrades and Filter Dentrification — **I - Immediate Upgrades**
Prepared by: D. Kopchynski — *Italics denote alternaitve work elements not in Phase*

Item Number	Description	Quantity	Unit	Unit Price	Total
1	Sensors		LS	$ 25,000.00	$0
2	Controller		LS	$ 3,000.00	$0
3	Installation Hardware / Cable		LS	$ 4,000.00	$0
4	Pilot Testing		LS	$ 35,000.00	$0
5	Operations Manual		LS	$ 29,500.00	$0
6	Misc Chemicals / Appurtenances		LS	$ 3,500.00	$0
					$0
	Items Below Do Not include Contingencies and Markups				$0
1	*RV Dump Station Improvements*	0	LS	$ 200,000.00	$0
2	**Reclaimed Water Pump Station Major Improv.**	1	LS	$ 350,000.00	$350,000
3	**Plant Electrical Improvements**	1	LS	$ 250,000.00	$250,000
4	**Plant SCADA, Controls, and Instrumentation**	1	LS	$ 250,000.00	$250,000
5					$0
6					$0
7					$0
8					$0
9					$0
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27	Contractor Installation at 10% of Equipment/Materials	1	LS	$85,000	$85,000
28	Mobilization at 5% of Equipment/Materials Costs	1	LS	$42,500	$42,500
29	Contractor Overhead and Profit at 10%	1	LS	$85,000	$85,000
30					$0
31					$0

	Subtotal		**$ 1,062,500**
Contingency	30%		
Sales Tax	8.7%		
Planning Level Construction Cost			**$ 1,473,688**
Administration, Legal	10%	$	147,369
Engineering/Permitting/Construction Management	20%	$	294,737.50
PROJECT TOTAL:		**$**	**1,915,794**

City of Yelm
Planning-Level Project Cost Opinion Worksheet - Liquid Stream Alternatives
WRF Sewer Facilities Plan

Alternative 2A: Phase II - SBR Ballasted Sedimentation
Prepared by: D. Kopchynski

II - 2020 Upgrades
Italics denote alternative work elements not in Phase

Item Number	Description	Quantity	Unit	Unit Price	Total
1	**Conversion to SBR Ballasted Sedimentation**	1	LS	$ 1,440,000.00	$1,440,000
2	**Ballasted Sedimentation Process Building**	1	LS	$ 150,000.00	$150,000
3	*Existing SBR Misc Work, Rails/Coatings/Piping*	0	LS	$ 75,000.00	$0
4	*SBR Process Blower Replacement*	0	LS	$ 350,000.00	$0
5	*Exsiting SBR Basin Diffuser Air Replacement*	0	LS	$ 700,000.00	$0
6	*RV Dump Station Improvements*	0	LS	$ 200,000.00	$0
7	**UV Light Disinfection for Primary Disinfection**	1	LS	$ 425,000.00	$425,000
8	**Chlorine Contact Basin Structural Modifications**	1	LS	$ 75,000.00	$75,000
9	**Secondary Liquid Hypochlorination System for Reclaimed Water Residual**	1	LS	$ 100,000.00	$100,000
10	**Reject Water Pump Station Replacement**	1	LS	$ 150,000.00	$150,000
11	*Intermediate Pump Station Upgrades*	0	LS	$ 200,000.00	$0
12	**Sludge Pump Station Improvements (Existing Plant Drain and Sludge Pump Station)**	1	LS	$ 250,000.00	$250,000
13	*Reclaimed Water Pump Station Major Improv.*	0	LS	$ 350,000.00	$0
14	*New Influent Chemical Feed Building*	0	LS	$ 250,000.00	$0
15	**Plant Electrical Improvements**	1	LS	$ 900,000.00	$900,000
16	**Plant SCADA, Controls, and Instrumentation**	1	LS	$ 600,000.00	$600,000
17	*Existing Tertiary Filter Internals Replacement with Backwash Upgrade*	0	LS	$ 362,000.00	$0
18	*Tertiary Filter Expansion with Backwash Upgrade*	0	LS	$ 450,000.00	$0
18	**Control Building Expansion**	1	LS	$ 150,000.00	$150,000
19	*New Plant Drain Pump Station*	0	LS	$ 350,000.00	$0
20	~~*Ballasted Sedimentation Pilot Plant*~~		LS	$ 250,000.00	$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35	Contractor Installation at 10% of Equipment/Materials	1	LS	$424,000	$424,000
36	Mobilization at 5% of Equipment/Materials Costs	1	LS	$212,000	$212,000
37	Contractor Overhead and Profit at 10%	1	LS	$424,000	$424,000
38					$0
39					$0
				Subtotal	**$ 5,300,000**
				Contingency 30%	
				Sales Tax 8.7%	
				Planning Level Construction Cost	**$ 7,351,100**
				Administration, Legal 10%	$ 735,110
				Engineering/Permitting/Construction Management 20%	$ 1,470,220
				PROJECT TOTAL:	**$ 9,556,430**

City of Yelm
Planning-Level Project Cost Opinion Worksheet - Liquid Stream Alternatives
WRF Sewer Facilities Plan

Alternative 2A: Phase III - SBR Ballasted Sedimentation **III - 2025 Upgrades**
Prepared by: D. Kopchynski

Item Number	Description	Quantity	Unit	Unit Price	Total
1	*Conversion to SBR Ballasted Sedimentation*		LS	$ 1,440,000.00	$0
2	*Ballasted Sedimentation Process Building*		LS	$ 150,000.00	$0
3	**Existing SBR Misc Work, Rails/Coatings/Piping**	3	LS	$ 75,000.00	$225,000
4	**SBR Process Blower Replacement**	1	LS	$ 350,000.00	$350,000
5	**Exsiting SBR Basin Diffuser Air Replacement**	1	LS	$ 700,000.00	$700,000
6	**RV Dump Station Improvements**	1	LS	$ 200,000.00	$200,000
7	*UV Light Disinfection for Primary Disinfection*		LS	$ 425,000.00	$0
8	*Chlorine Contact Basin Structural Modifications*		LS	$ 75,000.00	$0
9	*Secondary Liquid Hypochlorination System for Reclaimed Water Residual*		LS	$ 100,000.00	$0
10	*Reject Water Pump Station Replacement*		LS	$ 150,000.00	$0
11	**Intermediate Pump Station Upgrades**	1	LS	$ 200,000.00	$200,000
12	*Sludge Pump Station Improvements (Existing Plant Drain and Sludge Pump Station)*		LS	$ 250,000.00	$0
13	*Reclaimed Water Pump Station Major Improv.*		LS	$ 350,000.00	$0
14	**New Influent Chemical Feed Building**	1	LS	$ 250,000.00	$250,000
15	*Plant Electrical Improvements*	1	LS	$ 650,000.00	$650,000
16	*Plant SCADA, Controls, and Instrumentation*	1	LS	$ 250,000.00	$250,000
17	**Existing Tertiary Filter Internals Replacement with Backwash Upgrade**	1	LS	$ 362,000.00	$362,000
18	**Tertiary Filter Expansion with Backwash Upgrade**	1	LS	$ 450,000.00	$450,000
19	*Control Building Expansion*	0	LS	$ 150,000.00	$0
20	**New Plant Drain Pump Station**	1	LS	$ 350,000.00	$350,000
21	~~*Ballasted Sedimentation Pilot Plant*~~		LS	$ 250,000.00	$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
36	Contractor Installation at 10% of Equipment/Materials Cost	1	LS	$398,700	$398,700
37	Mobilization at 5% of Equipment/Materials Costs	1	LS	$199,350	$199,350
38	Contractor Overhead and Profit at 10%	1	LS	$398,700	$398,700
39					$0
40					$0
				Subtotal	**$ 4,983,750**
			Contingency	30%	
			Sales Tax	8.7%	
			Planning Level Construction Cost		**$ 6,912,461**
			Administration, Legal	10%	$ 691,246
			Engineering/Permitting/Construction Management	20%	$ 1,382,492
			PROJECT TOTAL:		**$ 8,986,200**

Appendix H

Engineer's Planning Level Estimate of Construction Costs for Recommended Alternatives

City of Yelm
Planning-Level Project Cost Opinion Worksheet - Liquid Stream Alternatives
WRF Sewer Facilities Plan - DRAFT

Alternative 2A: Phase I - Filter Denitrification — **II - Basic Process Improvements**
Prepared by: D. Kopchynski — *Italics denote alternaitve work elements not in Phase*

Item Number	Description	Quantity	Unit	Unit Price	Total
1	Sensors		LS	$ 25,000.00	$0
2	Controller		LS	$ 3,000.00	$0
3	Installation Hardware / Cable		LS	$ 4,000.00	$0
4	Pilot Testing		LS	$ 35,000.00	$0
5	Operations Manual		LS	$ 29,500.00	$0
6	Misc Chemicals / Appurtenances		LS	$ 3,500.00	$0
					$0
	Items Below Do Not include Contingencies and Markups				$0
1	*RV Dump Station Improvements*	0	LS	$ 200,000.00	$0
2	**Reclaimed Water Pump Station Major Improv.**	1	LS	$ 350,000.00	$350,000
3	**Plant Electrical Improvements**	1	LS	$ 250,000.00	$250,000
4	**Plant SCADA, Controls, and Instrumentation**	1	LS	$ 250,000.00	$250,000
5					$0
6					$0
7					$0
8					$0
9					$0
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27	Contractor Installation at 10% of Equipment/Materials	1	LS	$85,000	$85,000
28	Mobilization at 5% of Equipment/Materials Costs	1	LS	$42,500	$42,500
29	Contractor Overhead and Profit at 10%	1	LS	$85,000	$85,000
30					$0
31					$0

	Subtotal		**$ 1,062,500**
Contingency	30%		
Sales Tax	8.7%		
Planning Level Construction Cost			**$ 1,473,688**
Administration, Legal	10%	$	147,369
Engineering/Permitting/Construction Management	20%	$	294,737.50
PROJECT TOTAL:		**$**	**1,915,794**

City of Yelm
Planning-Level Project Cost Opinion Worksheet - Liquid Stream Alternatives
WRF Sewer Facilities Plan - DRAFT

Alternative 2A: Phase II - SBR Ballasted Sedimentation — **II - Basic Process Improvements**
Prepared by: D. Kopchynski — *Italics denote alternative work elements not in Phase*

Item Number	Description	Quantity	Unit	Unit Price	Total
1	**Conversion to SBR Ballasted Sedimentation**	1	LS	$ 1,440,000.00	$1,440,000
2	**Ballasted Sedimentation Process Building**	1	LS	$ 150,000.00	$150,000
3	*Existing SBR Misc Work, Rails/Coatings/Piping*	0	LS	$ 75,000.00	$0
4	*SBR Process Blower Replacement*	0	LS	$ 350,000.00	$0
5	*Exsiting SBR Basin Diffuser Air Replacement*	0	LS	$ 700,000.00	$0
6	*RV Dump Station Improvements*	0	LS	$ 200,000.00	$0
7	**UV Light Disinfection for Primary Disinfection**	1	LS	$ 425,000.00	$425,000
8	**Chlorine Contact Basin Structural Modifications**	1	LS	$ 75,000.00	$75,000
9	**Secondary Liquid Hypochlorination System for Reclaimed Water Residual**	1	LS	$ 100,000.00	$100,000
10	**Reject Water Pump Station Replacement**	1	LS	$ 150,000.00	$150,000
11	*Intermediate Pump Station Upgrades*	0	LS	$ 200,000.00	$0
12	**Sludge Pump Station Improvements (Existing Plant Drain and Sludge Pump Station)**	1	LS	$ 250,000.00	$250,000
13	*Reclaimed Water Pump Station Major Improv.*	0	LS	$ 350,000.00	$0
14	*New Influent Chemical Feed Building*	0	LS	$ 250,000.00	$0
15	**Plant Electrical Improvements**	1	LS	$ 900,000.00	$900,000
16	**Plant SCADA, Controls, and Instrumentation**	1	LS	$ 600,000.00	$600,000
17	*Existing Tertiary Filter Internals Replacement with Backwash Upgrade*	0	LS	$ 362,000.00	$0
18	*Tertiary Filter Expansion with Backwash Upgrade*	0	LS	$ 450,000.00	$0
18	**Control Building Expansion**	1	LS	$ 150,000.00	$150,000
19	*New Plant Drain Pump Station*	0	LS	$ 350,000.00	$0
20	~~*Ballasted Sedimentation Pilot Plant*~~		LS	$ 250,000.00	$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35	Contractor Installation at 10% of Equipment/Materials	1	LS	$424,000	$424,000
36	Mobilization at 5% of Equipment/Materials Costs	1	LS	$212,000	$212,000
37	Contractor Overhead and Profit at 10%	1	LS	$424,000	$424,000
38					$0
39					$0

		Subtotal	**$ 5,300,000**
	Contingency	30%	
	Sales Tax	8.7%	
	Planning Level Construction Cost		**$ 7,351,100**
	Administration, Legal	10%	$ 735,110
	Engineering/Permitting/Construction Management	20%	$ 1,470,220
	PROJECT TOTAL:		**$ 9,556,430**

City of Yelm
Planning-Level Project Cost Opinion Worksheet - Liquid Stream Alternatives
WRF Sewer Facilities Plan - DRAFT

Alternative 2A: Phase III - SBR Ballasted Sedimentation IIIA - Initial
Prepared by: D. Kopchynski

Item Number	Description	Quantity	Unit	Unit Price	Total
1	*Conversion to SBR Ballasted Sedimentation*		LS	$ 1,440,000.00	$0
2	*Ballasted Sedimentation Process Building*		LS	$ 150,000.00	$0
3	**Existing SBR Misc Work, Rails/Coatings/Piping**	3	LS	$ 75,000.00	$225,000
4	**SBR Process Blower Replacement**	1	LS	$ 350,000.00	$350,000
5	**Exsiting SBR Basin Diffuser Air Replacement**	1	LS	$ 700,000.00	$700,000
6	**RV Dump Station Improvements**	1	LS	$ 200,000.00	$200,000
7	*UV Light Disinfection for Primary Disinfection*		LS	$ 425,000.00	$0
8	*Chlorine Contact Basin Structural Modifications*		LS	$ 75,000.00	$0
9	*Secondary Liquid Hypochlorination System for Reclaimed Water Residual*		LS	$ 100,000.00	$0
10	*Reject Water Pump Station Replacement*		LS	$ 150,000.00	$0
11	**Intermediate Pump Station Upgrades**	1	LS	$ 200,000.00	$200,000
12	*Sludge Pump Station Improvements (Existing Plant Drain and Sludge Pump Station)*		LS	$ 250,000.00	$0
13	*Reclaimed Water Pump Station Major Improv.*		LS	$ 350,000.00	$0
14	**New Influent Chemical Feed Building**	1	LS	$ 250,000.00	$250,000
15	*Plant Electrical Improvements*	1	LS	$ 650,000.00	$650,000
16	*Plant SCADA, Controls, and Instrumentation*	1	LS	$ 250,000.00	$250,000
17	**Existing Tertiary Filter Internals Replacement with Backwash Upgrade**	1	LS	$ 362,000.00	$362,000
18	**Tertiary Filter Expansion with Backwash Upgrade**	1	LS	$ 450,000.00	$450,000
19	*Control Building Expansion*	0	LS	$ 150,000.00	$0
20	**New Plant Drain Pump Station**	1	LS	$ 350,000.00	$350,000
21	~~*Ballasted Sedimentation Pilot Plant*~~		LS	$ 250,000.00	$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
36	Contractor Installation at 10% of Equipment/Materials Cost	1	LS	$398,700	$398,700
37	Mobilization at 5% of Equipment/Materials Costs	1	LS	$199,350	$199,350
38	Contractor Overhead and Profit at 10%	1	LS	$398,700	$398,700
39					$0
40					$0

	Subtotal		**$ 4,983,750**
Contingency	30%		
Sales Tax	8.7%		
Planning Level Construction Cost			**$ 6,912,461**
Administration, Legal	10%	$	691,246
Engineering/Permitting/Construction Management	20%	$	1,382,492
PROJECT TOTAL:		**$**	**8,986,200**

City of Yelm
Planning-Level Cost Opinion Worksheet - Solids Stream Alternatives
WRF Sewer Facilities Plan - DRAFT

Alternative: SS 3: Phase I - Sludge Thickening and Dewatering Upgrades - Conducted with Liquid Stream Phase II
Prepared by: D. Kopchynski

Item Number	Description	Quantity	Unit	Unit Price	Total
1	*Lystek Class A Process*		LS	$ 1,500,000.00	$0
2	**New Drum Thickener and Dewatering Screw Press**	1	LS	$ 300,000.00	$300,000
3	**Solids Handling Building Modifications**	1	LS	$ 250,000.00	$250,000
4	**Polymer System Upgrades**	1	LS	$ 100,000.00	$100,000
5	**Sludge Storage Tank Repairs**	1	LS	$ 50,000.00	$50,000
6	**Temporary Thickening**	1	LS	$ 100,000.00	$100,000
7	**Dewatered Sludge Load Off Equipment**	1	LS	$ 150,000.00	$150,000
8	**Sludge Storage Tank Blowers**	1	LS	$ 50,000.00	$50,000
9	*Covered Biosolids Storage Pond*		LS	$ 250,000.00	$0
10	*NaOH System Upgrades*		LS	$ 50,000.00	$0
11	**Electrical Improvements**	1	LS	$ 250,000.00	$250,000
12	**Controls**	1	LS	$ 150,000.00	$150,000
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
					$0
	Contractor Installation at 10% of Equipment/Materia	1	LS	$140,000	$140,000
	Mobilization at 5% of Equipment/Materials Costs	1	LS	$70,000	$70,000
	Contractor Overhead and Profit at 10%	1	LS	$140,000	$140,000
					$0
					$0
				Subtotal	**$ 1,750,000**
			Contingency	30%	
			Sales Tax	8.7%	
			Planning Level Construction Cost		**$ 2,427,250**
			Administration, Legal	10%	$ 242,725
			Engineering/Permitting/Construction Management	20%	$ 485,450
			PROJECT TOTAL:		**$ 3,155,425**

City of Yelm
Planning-Level Cost Opinion Worksheet - Solids Stream Alternatives
WRF Sewer Facilities Plan - DRAFT

Alternative: SS 3: Phase II - Convert to Lystek Class A System, Capable of Accepting Septage along with WAS
Prepared by: D. Kopchynski

Item Number	Description	Quantity	Unit		Unit Price	Total
1	**Lystek Class A System**	1	LS	$	1,500,000.00	$1,500,000
2	*Replace Gravity Belt Thickener with New Drum Thickener, Add Dewatering Screw Press*		LS	$	300,000.00	$0
3	*Solids Handling Building Modifications*		LS	$	250,000.00	$0
4	*Polymer System Upgrades*		LS	$	100,000.00	$0
5	*Sludge Storage Tank repairs*		LS	$	50,000.00	$0
6	*Temporary Thickening*		LS	$	100,000.00	$0
7	*Dewatered Sludge Load Off Equipment*		LS	$	150,000.00	$0
8	**Covered Biosolids Storage Pond**	1	LS	$	250,000.00	$250,000
9	*Sludge Storage Tank Blowers*		LS	$	50,000.00	$0
10	**NaOH System Upgrades**	1	LS	$	50,000.00	$50,000
11	**Electrical Improvements**	1	LS	$	50,000.00	$50,000
12	**Controls**	1	LS	$	50,000.00	$50,000
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
	Contractor Installation at 10% of Equipment/Materi	1	LS		$190,000	$190,000
	Mobilization at 5% of Equipment/Materials Costs	1	LS		$95,000	$95,000
	Contractor Overhead and Profit at 10%	1	LS		$190,000	$190,000

	Subtotal	**$**	**2,375,000**
Contingency	30%		
Sales Tax	8.7%		
Planning Level Construction Cost		**$**	**3,294,125**
Administration, Legal	10%	$	329,413
Engineering/Permitting/Construction Management	20%	$	658,825
PROJECT TOTAL:		**$**	**4,282,363**

Appendix I

State Environmental Review Process (SERP) Checklist

State Environmental Review Process (SERP) Coversheet for SRF Applicants and Recipients

DEPARTMENT OF ECOLOGY
State of Washington

Applicant and Project Information	
Applicant Name (Agency): City of Yelm	
Project Title: Sewer Facilities Plan	
Project Contact Person: Ryan Johnstone, PE, Public Works Director	Telephone:360.458.8406
Address: 901 Rhoton Rd.,Yelm, WA 98597	
Email: ryanj@ci.yelm.wa.us	
Brief Project Description: As documented in the approved 2013 City of Yelm General Sewer Plan (Yelm GSP), the City of Yelm (City) will review critical upgrade requirements for their existing Water Reclamation Facility (WRF). This Sewer Facilities Plan (Plan) describes the development and evaluation of alternatives for liquid and solid waste stream treatment upgrades at the City's WRF. This Plan has been prepared in accordance with Washington Administrative Code (WAC) 173-240. Completing the projects recommended in this Plan will allow the City to provide continued reliable reclaimed water production, wastewater treatment, and waste solids handling to the City of Yelm while protecting and preserving the surrounding environment.	

Please submit all SERP documentation listed below together with this form to Ecology's Regional Engineer or Manager and the Environmental Review Coordinator for review and approval.

Check the boxes below to indicate that the SERP Packet includes the documentation for the items listed and complies with Ecology guidance and procedures. Provide comments for additional information when needed.

1. SEPA review documentation:
   a. ☒ SEPA checklist.
   b. ☐ The signed SEPA determination.
   c. ☐ Documentation that the lead agency solicited public comments (affidavit of publication or similar).
   d. ☐ Any comments received by the lead agency.
      ☐ No comments received.
   e. ☐ Categorical exemption. (*Categorical exemptions may be further reviewed by Ecology to ensure consistency with SERP. Provide documentation of the review and determination that the entire project as funded by federal SRF qualifies for categorical exemption.*)

   Comments:

2. Cost effectiveness analysis documentation (*required for all projects after FY 2017*):

   a. ☒ A complete description of the alternatives that were considered.

   b. ☒ Documentation that all appropriate alternatives were considered (regional approaches, reclaimed water, alternative technologies, I/I correction, etc.)

   c. ☒Comparison of monetary costs/benefits of each alternative.

      i. ☒ Consideration of capital, operation, maintenance, replacement costs (20 year present value).

      ii. ☒ Estimate of sewer rates using different financing alternatives.

      iii. ☐ Data for hardship analysis (if appropriate).

   d. ☒ Comparison of non-monetary costs/benefits of each alternative, including environmental impact, energy impacts, growth impacts, and community priorities.

   e. ☒ Information supports that selected alternative represents the cost effective alternative.

   Comments: Data can be found within Chapters 6 through 10 of the *Sewer Facilities Plan*.

3. Documentation of public participation in the selection process (required for all projects):

   a. ☒ Public meeting announcement.

   b. ☒ Meeting agenda listing discussion of environmental impacts.

   c. ☒ Meeting agenda listing discussion of alternatives, costs, and rate impacts.

   Comments: Meeting minutes can be found at the back of Appendix I of the *Sewer Facilities Plan*.

City of Yelm

Fee	
Date Received	
By	
File No.	

Community Development Department ENVIRONMENTAL CHECKLIST

Instructions:

The State Environmental Policy Act (SEPA) requires all governmental agencies to consider the environmental impacts of a proposal before making decisions. The purpose of this checklist is to provide information to help identify impacts from your proposal, to reduce or avoid impacts from the proposal if it can be done, and to help the City decide whether an EIS is required. An environmental impact statement (EIS) must be prepared for any proposal with probable significant adverse impacts on environmental quality.

This environmental checklist asks you to describe some basic information about your proposal. The City will use this checklist to determine whether the environmental impacts of your proposal are significant and require preparation of an EIS. You must answer each question accurately, carefully and to the best of your knowledge. Answer the questions briefly, but give the best description you can. In most cases, you should be able to answer the questions from your own observations or project plans without the need for experts. If you do not know the answer, or if a question does not apply to your proposal, write "do not know" or "does not apply". Complete answers to the questions now may avoid delays later. If the space provided is too small, feel free to attach additional sheets.

Some questions ask about governmental regulations, such as zoning, shoreline, and landmark designations. Answer these questions if you can. If you have problems, the city staff can assist you.

The checklist questions apply to all parts of your proposal even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. You may be asked to explain your answers or provide additional information for determining if there may be significant adverse impacts.

Nonproject Proposals Only:

Complete both the checklist (even though many questions may be answered "does not apply") and the **Supplemental Sheet for Nonproject Actions** (part D). For nonproject actions, the references in the checklist to the words "project," "applicant," and "property or site" should be read as "proposal," "proposer," and "affected geographic area," respectively.

CITY OF YELM

ENVIRONMENTAL CHECKLIST

CITY USE ONLY

FEE: $150.00
DATE REC'D
BY:
FILE NO.

A. BACKGROUND

1. Name of proposed project, if any:

Sewer Facilities Plan

2. Name of applicant:

City of Yelm

3. Address, phone number and email address of applicant and of any other contact person:

Ryan Johnstone, P.E.
Public Works Director
901 Rhoton Road
Yelm, WA 98597
Phone: 360-458-8499
Fax: 360-458-8417
Email: ryanj@ci.yelm.wa.us

4. Date checklist prepared:

April 19, 2016

5. Agency requesting checklist:

City of Yelm

6. Proposed timing or schedule (including phasing, if applicable):

A specific objective of this Plan is to deliver construction and operation of an upgraded water reclamation facility in a phased and cost effective manner during the 2018-2030 time period.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.

Yes, the projects will be delivered in phases during the 2018-2030 time period.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

Environmental Checklist and Determination of Nonsignificance for the Thurston County Comprehensive Plan Update as amended by Resolution number 14034 and Ordinance number 14035, November 2007.

Project specific environmental analyses will be prepared, if necessary, for the proposed projects identified in the Plan.

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain.

No.

10. List any government approvals or permits that will be needed for your proposal, if known.

The Washington State Departments of Ecology and Health must review and approve the Sewer Facilities Plan. Thurston County will review the Plan for consistency with the City of Yelm Comprehensive Plan and Joint Plan with Thurston County (2009). The Yelm City Council must approve and adopt the Plan before the final approval of the Plan by Ecology and Health.

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page.

As documented in the approved 2013 City of Yelm General Sewer Plan (Yelm GSP), the City of Yelm (City) will review critical upgrade requirements for their existing Water Reclamation Facility (WRF). This Sewer Facilities Plan (Plan) describes the development and evaluation of alternatives for liquid and solid waste stream treatment upgrades at the City's WRF. This Plan has been prepared in accordance with Washington Administrative Code (WAC) 173-240. Completing the projects recommended in this Plan will allow the City to provide continued reliable reclaimed water production, wastewater treatment, and waste solids handling to the City of Yelm while protecting and preserving the surrounding environment.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. You need not duplicate maps or detailed plans submitted with any permit applications related to this checklist.

The City of Yelm is located about 17 miles southeast of Olympia, Washington near the eastern boundary of Thurston County. The existing WRF is located in the northeast portion of the city, on Industrial zoned land, reached by an access road off of Northern Pacific Rd SE. The exact address of the site is 931 N P Rd NW, Yelm, WA 98597.

B. ENVIRONMENTAL ELEMENTS

1. **Earth**

a. General description of the site (circle one):
(flat), rolling, hilly, steep slopes, mountainous, other _____

b. What is the steepest slope on the site (approximate percent slope)?

The steepest slope on the site is approximately 27%.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any prime farmland.

The soils of Thurston County have been mapped and classified into 133 soil units by the United States Department of Agriculture, Soils Conservation Service (SCS). The majority of soils in the City of Yelm area are classified as either (1) Spanaway gravelly sandy or stony loam or (2) Everett very gravelly sandy loam. The characteristics of the soils have been grouped by the SCS as undulating and rolling, coarse and moderately coarse textured soils underlain by loose glacial outwash materials.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

There are no known unstable soils in the vicinity of the proposed projects identified in the Plan.

e. Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate source of fill.

Excavation, back filling, and/or grading activity could occur in association with proposed projects. In general, the amounts of grading and filling that would be required will be relatively modest. More specific information regarding quantities of filling and grading will be determined during project-level design. Where native materials are unsuitable for backfill, suitable materials will be imported from nearby sources.

The proposed projects will comply with the applicable local, state, and federal regulations and permits required for grading and filling activities.

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe.

Sedimentation impacts will occur during construction; erosion control will be required and shown on construction plans and specifications.

g. About what percent of the site will be covered with impervious surfaces after project construction such as asphalt or buildings?

Proposed projects will create minimal increases in impervious surfacing. Impervious surfaces will be approximately 23% of the site.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

Construction of proposed projects will employ Best Management Practices (BMPs) to reduce or control potential project-specific erosion. BMPs could include temporary erosion and control measures, surface water pollution prevention plans, and spill prevention control and countermeasures plans. Other examples of typical BMPs include installing filter fabric fences or hay bales, covering exposed soils, using temporary soil covers such as mulch, diverting stormwater with temporary berms, and using settling ponds or grass-lined swales to prevent sediment from

moving into receiving waters and storm drains. Site-specific erosion and sedimentation control provisions will be listed on construction plans and specifications. These projects will comply with the applicable erosion control provisions of the local and state jurisdictions.

2. **Air**

a. What types of emissions to the air would result from the proposal (i.e., dust, automobile exhaust, odors, industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.

Air emissions could result from these projects during construction. New facilities to be constructed under the proposal generally will not produce new/additional air emissions during operation. Temporary, localized emissions of fugitive dust and vehicle emissions could occur during construction of individual projects; however, these emissions are not anticipated to result in any significant impact on the overall ambient air quality in Yelm.

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.

No.

c. Proposed measures to reduce or control emissions or other impacts to air, if any:

Projects will include construction mitigation measures in order to reduce construction emissions and will comply with the Olympic Region Clean Air Agency (ORCAA) regulations to minimize fugitive particulate matter. Site-specific measures to reduce construction emissions could potentially include spraying areas of exposed soil with water for dust control, regular street cleaning, and reducing exhaust emissions by minimizing vehicle and equipment idling. Construction activities will comply with ORCAA's requirements for reasonable precautions to minimize fugitive dust. Construction equipment also could include emission-control devices on gasoline and diesel engines to reduce carbon monoxide (CO) and particulate emissions.

3. **Water**

a. Surface Water

1) Is there any surface water body or wetland on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds)? If yes, describe type and provide names. State what stream or river it flows into?

No.

2) Will the project require any work over, in, or adjacent to (within 300 feet) the described waters? If yes, please describe and attach available plans.

Not applicable.

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.

Not applicable.

4) Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.

No.

5) Does the proposal lie within a 100-year floodplain? If so, note elevation on the site plan.

No.

6) Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.

No waste materials will be directly discharged to surface waters.

b. Groundwater:

1) Will groundwater be withdrawn, or will water be discharged to groundwater? Give general description, purpose, and approximate quantities if known.

Dewatering may be required for construction of WRF upgrades. Prior to completing these projects, additional environmental investigation, including hydraulic modeling, would be completed to determine impacts.

2) Describe the underlying aquifer with regard to quality and quantity, sensitivity, protection, recharge areas, etc.

Proposed projects will not impact the underlying aquifer.

3) Describe waste material that will be discharged into or onto the ground from septic tanks or other sources, if any (such as domestic sewage; industrial byproducts; agricultural chemicals).

Proposed projects will not directly discharge waste materials from animals, humans, or its operational activities to groundwater.

c. Water Runoff (including storm water):

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

Construction activities could temporarily increase runoff, and associated erosion and sedimentation could affect water quality in the short term.

2) Could waste materials enter ground or surface waters? If so, generally describe.

No untreated waste materials will enter ground or surface waters as a result of properly operated sewer conveyance, treatment, and disposal facilities.

Construction activities could temporarily discharge materials, which will be controlled with site-specific BMPs and other mitigation measures.

d. Proposed measures to reduce or control surface, ground, and runoff water impacts, if any:

Construction activities will include measures to reduce potential surface water, groundwater, and runoff impacts, such as BMPs and other temporary erosion controls. Yelm will prepare required plans for stormwater pollution control and spill prevention.

All proposed projects will be designed, constructed, and operated to meet applicable local, state, and federal regulatory requirements to protect water resources. All Yelm projects will obtain the necessary permits and approvals concerning surface water, groundwater, and storm water runoff. Proposed projects will comply with applicable local storm water and drainage codes of the appropriate permitting jurisdictions.

4. **Plants**

a. Check or circle types of vegetation found on the site:

__X__ deciduous tree: alder, maple, (oak), aspen, other
__X__ evergreen tree: (fir), cedar, pine, other
__X__ shrubs
__X__ grasses
_____ pasture
_____ crops or grains
_____ wet soil plants: cattail, buttercup, bulrush, skunk cabbage, other
_____ water plants: water lily, eelgrass, milfoil, other
__X__ other types of vegetation

b. What kind and amount of vegetation will be removed or altered?

Vegetation could be affected in association with proposed projects. Proposed projects would occur in the immediate vicinity of the WRF, and the amounts of vegetation to be removed or altered likely would be relatively small and localized. Vegetation on or adjacent to projects site, where present, could be disturbed by construction activities.

If areas of vegetation are removed or altered, vegetation will be restored following construction.

c. List threatened or endangered species known to be on or near the site.

As part of the Thurston Highlands EIS effort, a comprehensive query of the U.S. Fish and Wildlife Service (USFWS) website was conducted for documentation of any Listed or Proposed Endangered and Threatened Species and Critical Habitat, Candidate Species and Species of Concern occurring within a 1.5-mile radius of the project area. In addition, a thorough search was conducted of the National Marine Fisheries Service, Northwest Regional Office, Office of Protected Resources web pages. Both of these websites were accessed October 4, 2006. No Federally-listed species or critical habitat records were found for the Thurston Highlands property. The prevalence of low-diversity, replanted, mostly young Douglas fir forest does not afford preferred habitat conditions for listed species that could potentially occur,

such as Northern spotted owl (Strix occidentalis). Furthermore, the absence of prairie habitat conditions within Thurston Highlands eliminates the potential for listed plant and animal species associated with this habitat type to occur. The only potential Federally-listed species that might occur within Thurston Highlands is an aquatic plant, water howellia (Howellia aquatilis), that could occur within the sphagnum bog habitat associated with the Wetland A complex.

The Draft Biological Assessment prepared for the SR 510/Yelm Loop Highway Corridor (WSDOT, May 2007) investigated the presence of threatened and endangered species within the same general project area as the Yelm sewer system service area. Within the project area, it was determined that listed fish species included Puget Sound Chinook salmon and bull trout. Designated critical habitat for the Puget Sound Chinook salmon evolutionarily significant unit (ESU) occurs in portions of the mainstem Nisqually River and the lowest reaches of Yelm Creek (river mile [RM] 0.0 to 0.7). The closest designated critical habitat for the Coastal-Puget Sound bull trout distinct population segment (DPS) is in the Nisqually River. Puget Sound steelhead, proposed for listing as a threatened species, may also occur in the project vicinity. There are no known listed plant species identified in the project; however, a federal species of concern (*Aster curtus*, white-top aster) may occur in the project vicinity. Bald eagles were the single wildlife species addressed in this BA.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

Projects will be designed to minimize potential impacts on vegetation. Where necessary to remove or alter areas of vegetation, vegetation will be restored following construction. Areas will be restored, where possible, with plantings of native species and other appropriate vegetation. Where appropriate, Yelm will prepare a landscaping plan for individual projects, consistent with Yelm development guidelines.

5. **Animals**

a. Circle any birds and animals that have been observed on or near the site or are known to be on or near the site:

birds: (hawk), heron, (ducks), (eagle), (songbirds),
other: **Passerine species, raptors, woodpecker, jays, crows**
mammals: (deer), bear, (elk), beaver, other: **Cougar**
fish: bass, salmon, trout, shellfish, other:_____

b. List any priority, threatened or endangered species known to be on or near the site.

Puget Sound Chinook salmon and bull trout are known to be nearby. However, there are none located at the project site and none will be impacted.

c. Is the site part of a migration route? If so, explain.

No.

d. Proposed measures to preserve or enhance wildlife, if any:

None, no impacts anticipated.

6. Energy and Natural Resources

a. What kinds of energy (electric, natural gas, gasoline, heating oil, wood, solar etc.) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, transportation, etc.

The programs and proposed projects described in the Plan will not require any major increase in regional long-term energy use. The Plan includes the construction of sewer facilities which will require pumping and power. The existing electrical infrastructure within the vicinity of the existing sewer facilities is adequate to handle future loads.

Construction of proposed projects will require energy for construction equipment and vehicles, which would temporarily use electricity and gasoline/diesel fuel. Energy use during construction would be short term and would have a negligible impact on regional energy supplies. Necessary equipment will consist of standard construction equipment.

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.

The Plan does not involve building large, new structures or planting vegetation that would block access to the sun for adjacent properties.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

Construction activities and operation of Yelm facilities will include measures to conserve energy, such as selection of energy-efficient equipment and implementation of energy-efficient operational practices, where applicable.

7. Environmental Health

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spills, of hazardous waste, that could occur as a result of this proposal? If so, describe.

No.

1) Describe special emergency services that might be required.

Emergency services could be required to clean up spills or respond to worker injuries during construction and, possibly, during the operation and maintenance of completed facilities. However, operation of future infrastructure anticipated under the Plan likely would not require special emergency services.

2) Proposed measures to reduce or control environmental health hazards, if any:

Site-specific hazardous material and spill control plans have been developed to provide a response plan in the event of a hazardous chemical spill at the existing WRF.

A Construction Contingency Plan and a Health and Safety Plan will be required of the contractor before work commences.

b. Noise

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment operation, other)?

Projects planned for implementation as part of the Plan will take place within the immediate vicinity of the WRF. The existing noise sources at this location would not affect projects identified the Plan.

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.

Construction of proposed projects could result in localized construction noise, which would be a short-term impact and would be reduced with project-specific mitigation measures. The design and operation of new facilities would comply with any applicable local noise ordinances.

Potential construction noise would be most noticeable at residences, institutions, and park/public open spaces near construction activities. Short-term noise from construction equipment would be limited to the allowable maximum noise levels established by City code, or the applicable noise codes of other local jurisdictions where projects are located.

After completion of the proposed projects, occasional noise from equipment and vehicles used for on-going routine maintenance and repair may occur. Such noise would be limited to daytime hours, except for noise associated with responses to certain unanticipated emergencies and the operation of the standby generator at the existing WRF site.

3) Proposed measures to reduce or control noise impacts, if any:

Construction of projects will include reasonable mitigation measures, as appropriate, to reduce potential site-specific construction noise impacts. Reasonable construction mitigation could include restrictions on nighttime construction activities, mufflers and enclosures for equipment, turning off idling equipment, and locating equipment farther away from receptors. All construction work will be performed in compliance with the applicable local noise ordinances. Prior to the start of construction, Yelm will coordinate construction activities with affected businesses, institutions, and residences that may be sensitive to construction-related noise, dust, or traffic.

Construction work will be conducted during normal business hours and all future facilities will be located, designed, and operated within applicable local noise ordinance standards.

8. **Land and Shoreline Use**

a. What is the current use of the site and adjacent properties?

Based on analysis of the City zoning designations within the current city limits, the City's WRF currently exists on industrial land surrounded by primarily residentially zoned land with some commercially zoned land to the south of the WRF.

b. Has the site been used for mineral excavation, agriculture or forestry? If so, describe.

Some properties in the vicinity of the wastewater service area, specifically the southwest portion of the City UGA, have been managed for commercial forestry in the past. However, the land where the WRF is located has not been used in this capacity.

c. Describe any structures on the site.

The WRF includes treatment basins and single-story structures housing treatment equipment or for the support of operations staff.

d. Will any structures be demolished? If so, what?

No.

e. What is the current comprehensive plan designation of the site?

The current comprehensive plan designation of the site of the existing WRF is "Industrial".

f. What is the current zoning classification of the site?

Zoning around the existing WRF is "Industrial".

g. If applicable, what is the current shoreline master program designation of the site?

Not applicable.

h. Has any part of the site been classified as a "natural resource", "critical" or "environmentally sensitive" area? If so, specify.

The entire City is located in a critical aquifer recharge area. Although the City of Yelm has designated environmentally sensitive areas, projects identified in the Plan will be sited outside of these areas.

i. Approximately how many people would reside or work in the completed project?

No people will reside in the upgraded WRF. Up to 6 people will be working there.

j. Approximately how many people would the completed project displace?

None.

k. Proposed measures to avoid or reduce displacement impacts, if any:

Not applicable.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

Prior to construction of any future projects, Yelm will apply for and obtain the applicable land use permits and approvals. Design, construction, and operation of the upgraded WRF will follow local zoning and development standards for mitigating potential impacts on adjacent land uses. Future individual permits would include site-specific conditions or mitigation measures to meet the requirements of the applicable land use, zoning, and shoreline codes and policies.

The City has prepared and adopted Yelm's Comprehensive Plan, which was last updated in 2007. The Comprehensive Plan contains policies on utilities and identifies areas for future growth, which have been sources of direction for the Yelm's sewer planning. The Plan is consistent with the goals and the policies of the Utilities Element of the Comprehensive Plan. Any population growth facilitated by implementation of the Plan generally would occur in areas identified for future development in Yelm's Comprehensive Plan and in the comprehensive plans of other local jurisdictions.

The Plan is consistent with the requirements of the Growth Management Act (GMA) and local and regional land use plans. The City has also updated its Comprehensive Plan in 2009 to adopt population projections consistent with the Thurston County Comprehensive Plan.

9. **Housing**

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

None.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

None.

c. Proposed measures to reduce or control housing impacts, if any:

Not Applicable.

10. **Aesthetics**

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

The exact heights of proposed structures are unknown. However, no proposed structures will be higher than the height of the tallest existing structure at the project site, which stands at approximately 30' above grade.

Similarly, the principal exterior building material proposed is unknown, but will resemble materials on existing structures at the project site.

b. What views in the immediate vicinity would be altered or obstructed?

No views in the immediate vicinity would be altered or obstructed.

c. Proposed measures to reduce or control aesthetic impacts, if any:

Not applicable.

11. **Light and Glare**

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

Implementation of the Plan would not introduce major new sources of light or glare.

Construction activities could be short-term sources of light and glare; however, because most construction activities would be limited by the local noise ordinances to avoid nighttime hours, most construction would occur during daytime hours. The lighting requirements for future individual projects would be determined during the design phase to comply with current lighting standards and local codes.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

No.

c. What existing off-site sources of light or glare may affect your proposal?

Future Yelm projects under the Plan would not be affected by other existing off-site sources of light or glare.

d. Proposed measures to reduce or control light and glare impacts, if any:

Not applicable.

12. **Recreation**

a. What designated and informal recreational opportunities are in the immediate vicinity?

None.

b. Would the proposed project displace any existing recreational uses? If so, describe.

No.

c. Proposed measures to reduce or control impacts or provide recreation opportunities:

Not applicable.

13. **Historic and Cultural Preservation**

a. Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.

Because the planning area is located within an area used by Native American Tribes in the past, there is a possibility of discovering cultural materials. Infrastructure construction is generally related to previously developed areas and for facilities upgrades at the existing WRF, discovering new historical or cultural artifacts would not be expected.

b. Generally describe any landmarks or evidence of historic, archeological, scientific, or cultural importance known to be on or next to the site.

Communications with staff representatives of the Nisqually Indian Tribe during the preparation of the permitting documents for the Thurston Highlands MPC did not indicate significant likelihood of former Native American use of the site or vicinity.

c. Proposed measures to reduce or control impacts, if any:

If it is determined that there is a potential for cultural, historic, or archaeological sites to be encountered during construction, a plan will be included in construction contract documents. This plan would require that if any cultural, archaeological, or historic resources were encountered during excavation, Yelm would immediately consult with the state and local historic preservation offices and with affected Tribes regarding site-specific mitigation measures. Work in that immediate area would be suspended, and the find would be examined and documented by a professional archaeologist or historian. Decisions regarding appropriate mitigation measures and further action would be made before construction in the area of discovery was allowed to resume.

14. **Transportation**

a. Identify sidewalks, trails, public streets and highways serving the site, and describe proposed access to the existing street system. Show on site plans, if any.

The existing WRF is reached solely by an access road off of Northern Pacific Rd SE. There are no other sidewalks, trail, public streets, or highways serving the site.

b. Is site currently served by public transit? By what means? If not, what plans exist for transit service?

The WRF is accessed almost exclusively by a relatively small number of operations and maintenance staff and is not accessible to the public, making public transit unnecessary. Therefore, the site is not currently served by public transit and no plans exist to add service.

c. How many parking spaces would the completed project have? How many would the project eliminate?

The project does not plan to add or eliminate any parking spaces.

d. Will the proposal require any new sidewalks, trails, roads or streets, or improvements to existing sidewalks, trails, roads or streets, not including driveways? If so, generally describe (indicate whether public or private).

No.

e. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.

No.

f. How many vehicular trips per day would be generated by the completed project? If known, indicate when peak volumes would occur.

Operation of WRF upgrades would not generate additional vehicular trips as compared to existing facility operation.

Construction activities would temporarily generate vehicle trips for workers and hauling materials. The number of construction vehicles is anticipated to be relatively small compared to traffic on local roadways.

g. Proposed measures to reduce or control transportation impacts, if any:

Construction of proposed projects will include measures to reduce short-term impacts on affected roadways and other transportation facilities. Access to residences and businesses from local roadways will be maintained during the construction periods. Vehicular travel along local roadways also will be maintained to allow passage of emergency service vehicles.

Traffic control plans for individual projects will ensure continued circulation and access during construction. Plans potentially could include provisions to address worker parking, such as requirements that workers carpool to the job site or that the contractor provide worker shuttles from off-site parking locations. Construction activities will be coordinated with affected landowners, local businesses, emergency service providers, transit services, other local jurisdictions, and the local jurisdictions.

15. **Public Services**

a. Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe:

No.

b. Proposed measures to reduce or control direct impacts on public services, if any.

Not applicable.

16. **Utilities**

a. Circle utilities currently available at the site: electricity, natural gas, water, refuse service, telephone, sanitary sewer, septic system, other

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.

Infrastructure improvements will not require any additional utility service.

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the City of Yelm is relying on them to make its decision.

Signature: _____

Date Submitted: _____

SUPPLEMENTAL ENVIRONMENTAL CHECKLIST FOR NONPROJECT ACTIONS

(Do not use this sheet for project actions.)

When answering these questions, be aware of the extent of the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substances; or production of noise?

   It will not.

   Proposed measures to avoid or reduce such increases are:

   Not applicable.

2. How would the proposal be likely to affect plants, animals, fish, or marine life?

   It will not.

   Proposed measures to protect or conserve plants, animals, fish, or marine life are:

   Not applicable.

3. How would the proposal be likely to deplete energy or natural resources?

   It will not have a significant impact.

   Proposed measures to protect or conserve energy and natural resources are:

   Not applicable.

4. How would the proposal be likely to use or affect critical or environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection, such as parks, wilderness, wild and scenic rivers, threatened or endangered species habitat, historic or cultural sites, wetlands, floodplains, or natural resource areas?

   It will not.

   Proposed measures to protect such resources or to avoid or reduce impacts are:

   Not applicable.

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

   It will have no impact.

Proposed measures to avoid or reduce shoreline and land use impacts are:

Not applicable.

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

It will not.

Proposed measures to reduce or respond to such demand(s) are:

Not applicable.

7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

It will not conflict.

YELM CITY COUNCIL STUDY SESSION
WEDNESDAY, FEBRUARY 25, 2015 5:00 P.M.

Mayor Harding called the meeting to order at 5:00 p.m.

Present: Councilmembers: JW Foster, Joe Baker, Jennifer Littlefield, Tracey Wood, Ken Garmann, Russ Hendrickson. Staff: Shelly Badger, Grant Beck, Ryan Johnstone, Guests: Dr. David Kopchynski and Brian Bunker, Parametrix

4a. **Reclaimed Water Plant Update-** Ryan Johnstone introduced guests from Parametrix working on a Pilot Study at WWTP to address the plant challenges. Ryan provided a ppt, explaining it is all about meeting the permit for producing Class A reclaimed water. The many factors for making permit include, maintaining total balance of nitrogen, ammonia, coli form and turbidity. All of which are essential to outflow into Centralia canal, Nisqually river, mitigate current and future water rights. Investigating solutions to address the increasing load into the plant and decreasing food supply for the essential bugs needed to treat the wastewater. The pilot study is narrowing the solution options, including sand filtering and introducing synthetic carbon. A menu of options and associated costs will be provided at the conclusion of the study. Mayor Harding thanked Parametrix for their stellar efforts evaluating best options to improve the production at the WWTP, one of this state's oldest reclaimed water plants.

4 b. **Thurston County, Draft County-Wide Planning Policies**. Grant Beck provided a draft, stating cities must be consistent with their Comp Plans and the GMA, and accommodate growth by law. Councilmember Isom was able to bring in things that Yelm wants to change, including balancing the documents so that policies for urbanizing cities and rural development in the county are equalized. Public Hearing has not been scheduled for the approval. Grant will provide additional materials to Council as requested.

5. **Mayor's Report**:

State repair of the guardrail at Creek St and 103rd discovered abutment cracks to the roadway bridge in need of repair. City will add this project to the Six Year Transportation Improvement Plan.

Review of MOA from Olympia regarding discontinuation of the purchase or use of products containing insect control neonicotinoids, considered to be contributing to the diminishing populations of bees and other pollinators and impacting agriculture and food security.

Grant provided, "Your City, Your Future" Comprehensive Plan Update 2015, in summary format previous known as the Vision Plan. Beginning in March, several venues for community outreach are planned to gauge if the Plan reflects what they are hearing. Determine if this is still the direction and it captures the vision.

The PW Teamsters 2015-2017 contract will be presented to Council 03-10-15.

6. **Council Initiatives**

Councilmember Foster recommended following Tumwater's example to sponsor a municipal government "Academy" for citizens". Mayor recommended that JW do the legwork and add this topic to the Council Retreat.

Councilmember Garmann - street lights on West Rd go out at 8 PM and come back on at 9 PM each night. Ryan Johnstone will follow up with PSE. Inquired about the ownership of the Y-3 right of way.

Councilmember Baker - completion schedule of Mosman realignment. DOT seasonal paving begins in April to coincide with the install of the traffic signal.

Councilmember Wood - potential hazard of the elevated sidewalk at the adjacent parking lot. Expressed frustration with the power line install that cross multiple times on McKenzie Ave SE.

Councilmember Foster inquired about petitioning the State to add a guard rail at 507 at Mill Pond.

Councilmember Littlefield asked for an update of the fuel tank removal from the old PW Yard.

Adjourn: 8:05 pm

_____ Attest_____

Ron Harding, Mayor Janine Schnepf, City Clerk

YELM CITY COUNCIL STUDY SESSION
WEDNESDAY, AUGUST 26, 2015 5:00 P.M.

Mayor Harding called the meeting to order at 5:00 p.m.

Present: Councilmembers: JW Foster, Joe Baker, Tracy Wood, Ken Garmann and Jennifer Littlefield
Staff: Grant Beck, Ryan Johnstone, Bob Rhoades, Aris McClelland and spouse. One citizen attending.

4. Sewer Treatment Capital Facilities Plan, Condition Report, Presenters: Dr. David Kopchynski PHD PE and Brian Bunker PE with Parametrix. Ryan Johnstone provided an update on the WWTP condition assessment prepared by Parametrix from construction in 1993 to its current condition. Also provided a graph map showing the sludge route processes from filtration to reclaimed water to clarify the basics, before providing more detail on the current condition of the Plant. In summary, the Plant was built to treat the conditions of the time. Challenges began in 2000 with balancing the nitrogen and ammonia levels as required by the State permitting for Class A reclaimed water. Other contributing factors were identified, including reduced BOD levels, heat and cold sensitivities, which required short term improvements. In 2010, work began on the Sewer Facility Plan and in April 2014 Parametrix was brought on for comprehensive research and to provide alternative solutions to fix. Parametrix is determining the best alternative options and will bring forward recommendations for the aging Plant.

5. Mayor's Report. Mayor Harding provided a draft of the Yelm Parks Advisory Board Committee's recommended Policies, Guidelines, Rules and Rates for the use of the Yelm Community Center currently under construction. Discussion followed with varied opinions about the rate structure; inquiries and suggestions about how the facility would be staffed; and how operations and maintenance costs would be supported. The policies and rates were modeled from other City's existing policies. Councilmember Garmann inquired about previous attempts to partner with SSCC for extension classes in Yelm. Response was that when the Community Center Bond failed, the design of the center was scaled down to 2 rooms and an office, insufficient for classrooms. However, there may be other opportunities with the school in the future. Mayor announced there will be a walk-thru tour and later suggested that Council review the draft and send their comments to him.

6. Council Initiatives
Discussion on the inconsistencies in the patchwork asphalt paving on Yelm Ave and suggested that they be marked and addressed, including the final striping, before the county crew leaves Yelm.

Inquired about hiring staff for vacant positions. Mayor responded that the Finance Director and PW Parks Maintenance positions have been filled, an offer has been made for WWTP Manager and staff is still working on filling the PW Manager position. There is no confirmed process for filling the City Administrator position at this time. City Hall will be closed to the public 2 hours per month to allow for staff meetings, training or to catch up uninterrupted. Schedule will be posted on city buildings for 2nd and 4th Tuesday mornings 8am-9am as closed to the public.

Skateboard Park bids came in high and will have to be re-evaluated. RFPs are out for prosecution services. Mosman water leak was identified as part of the reclaimed water line. Inquired about use of Restitution Center rather than Nisqually Jail. Increase visibility of pedestrian crosswalks.

Jennifer Littlefield announced September 12 is National Day of Service and is looking for community service projects for a group.

Adjourn: 8:05 p.m.

_____ Attest_____
Ron Harding, Mayor Janine Schnepf, City Clerk

YELM CITY COUNCIL STUDY SESSION
WEDNESDAY, FEBRUARY 24, 2016, 5:00 P.M.

Mayor Harding called the meeting to order at 5:05 p.m. Present: Councilmembers JW Foster, Tracy Wood, Tad Stillwell and Russ Hendrickson. Molly Carmody arrived 5:15 pm, Joe DePinto arrived 5:20 p.m. Staff: Grant Beck, Ryan Johnstone, Todd Stancil, Noah Crocker and Chad Bedlington. Guest Presenters: Parametrix, United Way and HomesFirst. Audience: Ken Garmann, WWTP staff: Bob Rhoades, Tony Edwards, Aris McClelland and spouse.

4a. Thurston County Community Initiative Partnership (CIP) Committee, Paul Knox, Executive Dir. – Mr. Knox invited the City of Yelm to join with the CIP to manage combined funding initiatives to facilitate health and human services needs within Thurston County. Objective to merge resources efficiently from multiple partners toward long-term solutions. Provided the current MOU with cities of Lacey, Olympia, Tumwater with United Way and TC Regional Health and Human Services. Each jurisdiction allocates one-half of one percent general sales and use tax to the CIP. Trudy Soucoup, Executive Director of HomesFirst provided a handout and spoke about their successes administering service to the community through rehabilitation of housing, services to veterans, youth training and recognized other services: Community Youth Services, South Sound Seniors, Reading Foundation, homeless, free clinics and food banks. Mr. Knox added that United Way is actively fundraising and is always looking for volunteers.

4b. Water Reclamation Facility Plan, Brian Bunker and David Kopchynsk from Parametrix joined Ryan Johnstone with review of the WWTP challenges to meet DOE permit requirements that drive approval of a plan to move forward with capital improvements. Parametrix has been working with city staff at the Plant since 2012, narrowing the options for solutions to improve the status and meet the challenges of the aging plant. Reviewed the contributing factors, short term and long-term fixes and financial costs associated, while conforming to the environmental requirements. Council inquired about impact to future rates, grant opportunities, population capacity, and potential for future restrictions and alternate disposal of wastewater outside of treatment. Informed Council that in the next 2 months analysis will continue with more to bring to Council for consideration.

4c. Public Works Project Update-Chad Bedlington provided an update on current project and planning efforts.
1) AC Waterline replacement: Yelm Ave between 2nd & 3rd begin April-May for approx 90-120 days, mostly at night.
2) SW Well 1 A: $4.9 million construction for 600,000 gal reservoir, booster pump, water treatment is 37% complete.
3) Mosman Ave Phase II, $1.5 m collector arterial in permitting phase, funding opportunities for ROW acquisition.
4) SR 507 Sidewalk extensions from Mosman to Washington. 5) Skatepark on schedule at 63% complete for April opening. Future: Stormwater Management Plan, policies and procedures currently at DOE review, bring to Council in March 2016: Water System Plan with RH2 March 2016: Playground equipment City Park, pursuing grant opportunities and will forward to Parks Advisory Committee, potential for cooperative efforts with local groups: Yelm on Puget Sound Energy list to Re-light Washington with LED lights and future savings.

5. Mayor's Report.
1) Uber approached TC cities to accept their established background check process for licensing drivers in all Thurston County cities and County. Announced Open House, March 9 at Olympia City Hall.
2) Critical Areas/Yelm Ave. renewed interest in changing setbacks from 1000 to 400 to open up available area for retail marijuana sales.
CONCENSUS to maintain 1,000 ft setbacks.
3) Next study session will include Department presentations and Budget 101 workshop. 4) AWC Board looking for nominations.

6. Council Initiatives
1) Councilmember Stillwell suggested Councilmembers be assigned as liaison with Dept Heads
2) Inquired about City adding a Facebook page.
1) Councilmember Carmody recommended collaborating with the Nisqually Tribe prior to and during the Alaska to Nisqually Canoe Journey. 2) Inquired about allowances for Food Trucks in Yelm.
1) Councilmember Foster wanted to follow-up on previous week's major traffic backup through Yelm and lack of reporting. Incident may help in future statewide funding opportunities through TRPC and state legislature. 2) Yelm Schools Dollars for Scholars this Saturday, March 5, 2016.
1) Councilmember DePinto concern for safety at crosswalks, particularly at 1st Street at School District Office. Direct complaints to Chief Stancil.

Adjourn: 8:25 p.m.

_____ Attest_____
Ron Harding, Mayor Janine Schnepf, City Clerk